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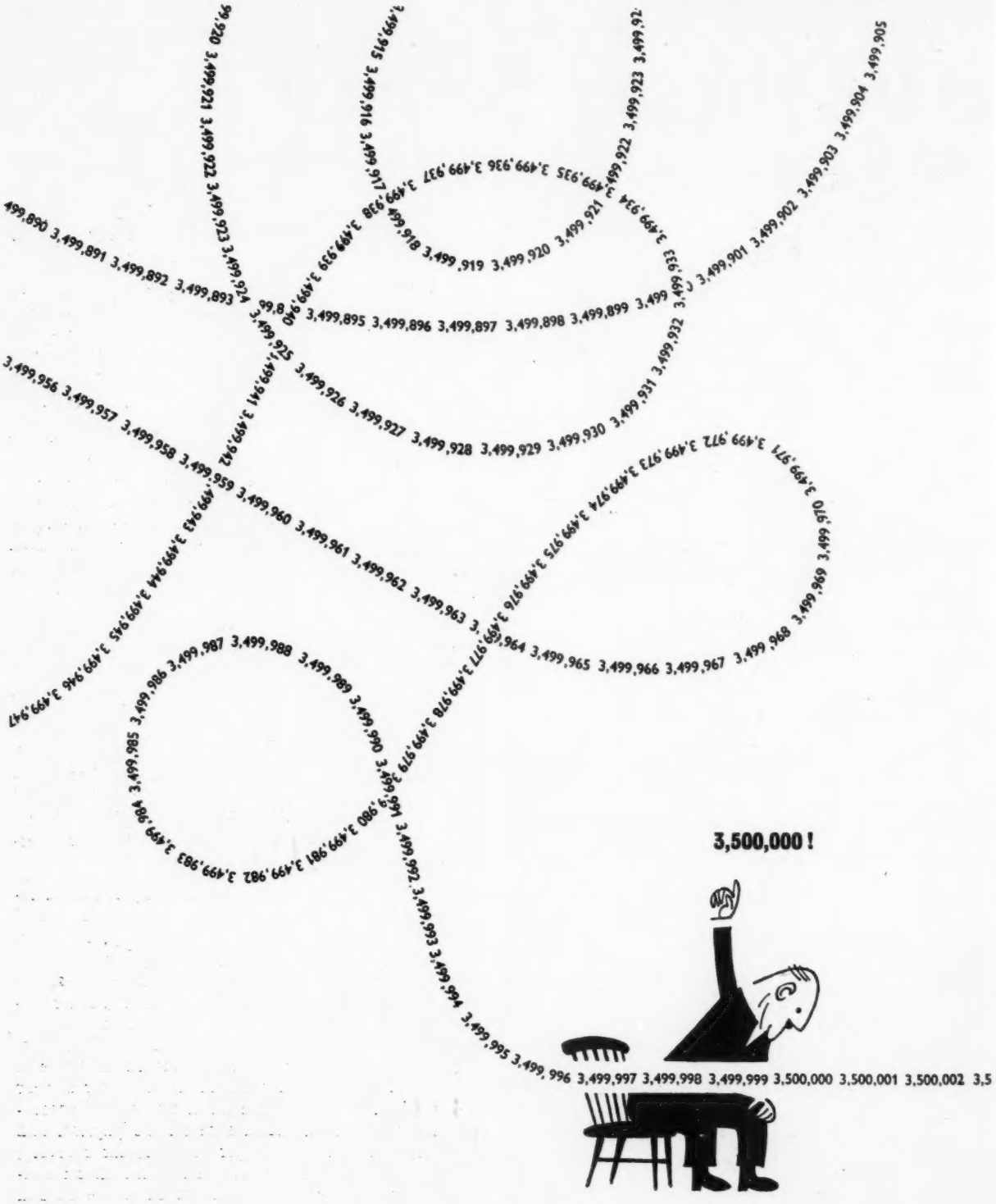
Tailoring the Metal to the Job

THE need for materials with strength at high temperatures, superior over-all strength characteristics and oxidation resistance, and other enhanced structural properties, has spurred basic research in two directions, the first being the development of new materials possessing the required properties and the second the re-examination of existing materials. Lt. R. A. Schalow, of the U.S. Air Research and Development Command, summed up these objectives neatly when he told the convention of the American Institute of Mining, Metallurgical and Petroleum Engineers, held recently at St. Louis, that many metal applications in missiles and space vehicles would require metals and alloys having tailor-made properties. This observation could equally well be applied to such industries as electronics and nuclear power generation, whose requirements are also becoming more and more exacting.

Pure metals have revealed properties unknown in metals produced by former technology. At the same time, as technology advances, we are learning more about the effect of foreign elements in minor amounts upon the chemical and physical properties of metals. New chapters in metallurgical history are being opened by such developments as ultra high pressure research, described at the convention by Mr. W. G. Field, of the U.S. Air Force Research Division, who stated that this work would uncover further knowledge on metals science and solid state physics and would also lead to the development of new materials with specially designed properties. According to Mr. Field it will also open up new information concerning geology and mineral deposits.

The demand for ever purer metals can scarcely fail to be reflected in all stages of ore extraction, minerals separation and metal extraction. It becomes increasingly necessary, therefore, that there should be a unified approach to the problems associated with the extraction of pure metals, as advocated at the convention by Dr. C. A. Krier, of Battelle Memorial Institute. Dr. Krier emphasized that the production of high purity metals was becoming more and more important in the field of extractive and physical metallurgy because purity is often the key to ductility and ease of fabrication of many high temperature metals required for nuclear and aerospace applications. Extractive metallurgy should accordingly be viewed as the art and science of all the physical and chemical steps from mineral and ore processing to the recovery, refining and purification of these metals. If the extractive metallurgist is going to sell his product, he must be aware of and sympathetic toward the requirements and problems of the physical metallurgist and of all his other "relatives" in the field of metallurgy.

Closely in accordance with the views expressed by Dr. Krier were some of the principal points made by Mr. K. C. Li, president of the Wah Chang Corporation, in a paper on tungsten presented to the beneficiation session of the convention. In view of its high refractory properties, great strength at high temperatures, and high



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nuclear cross section, tungsten is among the most promising of the "Space Age" metals. In common with other metals, it is being required in increasingly pure form. Tungsten minerals, however, are intimately combined with undesirable minerals. One of the points emphasized in this paper was that the very high melting point of tungsten precludes handling it like other metals. Tungsten must be highly refined before its reduction to metal. Thus the chemical processing of tungsten ores and concentrates actually constitutes what is normally the last stage in a metallurgical process, namely refining. Continued research in both metallurgy and chemistry will result in new and improved methods for the removal of impurities of ores and concentrates, from which tungsten (in common with other metals) can be expected to benefit.

Just as the ceaseless quest for improved speed and reliability in motor races and rallies has revolutionized the performance of the family car, so, too, will developments in the fields of missiles and space exploration, with their insatiable demands for metals of higher purity and more precisely tailored properties, have a profound impact on the mining and metal industries throughout the world, and on metal users as a whole.

Many of the materials developed primarily to meet the special needs of military programmes will become available, sooner or later, for the more mundane needs of civilian users, as is already occurring with titanium. At the same time, the search for more economical methods of producing high purity metals should have a favourable effect on mining and processing costs generally, thus helping to bring further tonnages of marginal ore within the limits of payability.

MORE ARCTIC IRON ORE FOR SWEDEN

Sweden's third largest iron ore field is to be opened up in the Svappavaara district in Arctic Sweden situated between Kiruna and the Malmberget fields, according to a recent announcement by the L.K.A.B. mining company, The deposits in the new mines are estimated at well over 300,000,000 tonnes, partly of high-grade ore.

The preliminary plan is to concentrate the mining activities on the Leveaniemi deposit on an open-cut basis. Investments over the next five years are estimated at more than 100,000,000 Kr. (£6,900,000) for the mining plant proper. Output in the first year of operations is scheduled at 500,000 tonnes to be stepped up to 3,000,000 tonnes by 1967 or 1968.

At the same time the Swedish State Railways plan to build a 25-mile line from Svappavaara to Kiruna costing 40,000,000 Kr. (£2,750,000). The line will be electrified, designed for automatic operation, and will permit an axle load of 25 tonnes.

Production at L.K.A.B.'s Kiruna and Malmberget mines reached a new peak of 15,700,000 tonnes in 1960. Planned expansions are estimated to increase Kiruna's output to 15,000,000 tonnes and Malmberget's to 6,000,000 tonnes by 1965. With the addition of Svappavaara the company's output should reach about 24,000,000 tonnes in the latter half of the 1960's.

Shipments of Swedish iron ore from the Norwegian port of Narvik reached an all-time high of about 12,300,000 tonnes last year, 2,200,000 tonnes more than in 1959. But since the capacity of the present "Iron ore railway" in this district and the existing port facilities of Narvik suffice only for handling output from Kiruna, the Svappavaara ore will be shipped through the Swedish port of Lulea at the northernmost end of the Gulf of Bothnia.

Sweden exported some 20,000,000 tonnes of iron ore last year compared with 15,600,000 tonnes in the previous year and 17,500,000 tonnes for the record year of 1957. Revenue from the shipments stood for 1960 at 1,060,000,000 Kr., above the 1959 figure of 842,000,000 Kr., but lower than those of 1,099,000,000 Kr. recorded for 1957 when prices were considerably higher.

The quantitative increase in exports of last year by 28 per cent over 1959 was due mainly to the improvement in the West German steel market. Both production and exports of the Swedish iron ore industry are expected to increase further over 1961

EXPANSION OF INDIA'S REFRACTORY INDUSTRY

The commissioning of the three public sector steel plants and the expansion of the private sector plants has given the refractory industry in India a new significance. The Third Plan envisages the setting up of another public sector plant at Bokaro, the doubling of the capacity of the existing State plants, and the establishment of several other metal industries which will call for greatly increased use of refractories. The Development Wing of the Ministry of Commerce and Industry has recently assessed the need for additional capacity in this respect.

In line with the Third Five-Year Plan target of 10,200,000 tons of ingot steel and 1,500,000 tons of saleable pig iron and the programme of development in other fields, such as chemicals, glass, cement, power generation, etc., a production target of 1,600,000 tons per annum has been prescribed for the refractory industry for the Third Plan.

To achieve this target, the industry must gear up for an installed capacity of at least 2,000,000 tons per annum during the next three years or so. The present installed capacity is about 800,000 tons per annum while actual production is only 500,000 tons per annum. In each of the years 1958 and 1959 India's imports of refractories were valued at Rs. 33,000,000 while in the first nine months of 1960 they were valued at Rs. 19,400,000. Although an additional capacity of 1,500,000 tons has been sponsored by the Development Wing, on present estimates, only about 700,000 tons out of the latter is expected to materalize by 1963.

As the demand for silica bricks is likely to go down in the event of adoption of all-basic open-hearth roof by the steel industry, the need for filling the gap is not urgent, but it could probably best be met through additional capacity on the following lines: (1) firebricks for ladles (60,000 tons); (2) firebricks for blast furnaces (20,000 tons); (3) Refractories for glass industry (10,000) tons); (4) basic refractories (burnt, chemically bonded and steel clad) (150,000 tons); (5) dead-burnt magnesite (150,000 tons), totalling 390,000 tons.

Raw Material Resources for the manufacture of refractories are fireclay, quartzite, chromite, magnesite and bauxite. India has adequate resources of these materials and their occurrences are as follows: *Fireclay:* West Bengal (Burdwan district); Bihar (Manbhum and Balamau districts); Madhya Pradesh (Jubbalpore district); Mysore (Bangalore and Kolar districts); and Madras (South Arcot district). *Magnesite:* Madras (Salem district); Mysore (Mysore district) and the recently discovered deposits in Uttar Pradesh (Almora) and Rajasthan. *Chromite:* Bihar (Singhbhum) Andhra (Kistna); Mysore (Mysore and Hassan districts) and Orissa (Keonjhar and Anandpur districts). *Quartzite:* Bihar (Dinsukhia), Madhya Pradesh (Jubbalpore), Mysore (Bangalore), Rajasthan (Ajmer), Andhra (Hyderabad) and Madras. *Bauxite:* Bihar (Ranchi), Madhya Pradesh (Katni and Jubbalpore districts), Maharashtra (Ratnagiri), Gujarat (Saurashtra), Madras (Salem) and Orissa (Kalahandi district).

Essential items of plant and equipment for the manufacture of refractories fall into four categories: (i) *Raw Material Processing Section:* jaw-crushers, elevators, conveyors, cone crusher, edge runner, conical ball with vibrating screen, etc. (ii) *Moulding Shop:* extrusion presses, heavy duty presses, pneumatic rammers. (iii) *Kiln Section:* tunnel dryer, drying cars, gas producer, tunnel kiln, rotary kiln (for dead-burnt magnesite). (iv) *Workshop Equipment and Testing Equipment.* Most of these items may have to be imported, the sources of supply being the United Kingdom, West Germany, Czechoslovakia, Yugoslavia, Japan and the U.S.

CORNISH MINERS' PLEA FOR TAX REVISION

Once again the Cornish Mining Development Association in its annual report for 1960-1 appeals to the government to revise its mining taxation policy. If tax reliefs were granted as in Eire, says the Association, they would cost the Exchequer little or nothing for there are now no new mining companies to tax, whereas if such concessions resulted in a revival of the industry there would be additional revenue from it within a few years. Yet another point of grievance arises on account of the Government's new re-rating proposals which "are likely to bear with particular severity on the few remaining companies mining tin in Britain".

Attention is also drawn to the revived interest in Cornish mines. During the year a team of geologists equipped with diving apparatus has been examining underwater rock exposures on the north coast between St. Agnes and Perranporth and for a mile off-shore. It is intended to follow this work by intensive diamond drilling at Cligga Head. A considerable part of the mineral potential of Cornwall probably lies beneath the sea and as diving makes possible the examination of geology for about two miles offshore, the total area of prospecting ground in West Cornwall — west of a line joining Newquay and Truro — is increased by just over half.

On the vexed question of the reopening of the small Carnelloe tin mine west of Zennor the Association, pointing out that if development does take place it is likely to be seawards like the Levant and Bottallack mines, claims that the surface works of the mine would be invisible from Zennor and in any case could have little if any adverse effect on the scenery of the area. However, because of the agitation against the proposal, loudly publicized in the local and national press, the Minister of Housing and Local Government took the matter out of the hands of the County Planning Authority and a public enquiry will be held at Penzance on May 10 next when the Association will support the application for planning permission at Carnelloe.

SOVIET COMPETITION WORRIES CANADIAN MINERS

The value of Canadian mineral exports reached an all-time high of $1,708,891,000 in 1960, about $184,000,000 higher than the previous peak of $1,525,259,000 in 1959, according to estimates made by *The Northern Miner.* The principal gains last year were in gold, copper, nickel, and to a lesser extent in asbestos and zinc. A range of smaller gains were also recorded for sulphur, cobalt, cadmium, lead, selenium and the platinum metals. As might have been expected uranium accounted for the biggest fall. The value of gypsum and salt exports also declined.

In spite of their impressive achievement in overseas markets the Canadian mining industry is perturbed by keener competition from other mineral producers, especially those in the Soviet *bloc,* according to statements made by representatives of the industry to the Senate Committee on Manpower and Employment which met in Ottawa recently. One delegate said that competition from exports of asbestos from the Soviet *bloc,* particularly from Russia itself, had become serious. It was claimed that Russia is currently producing about 1,000,000 tons of asbestos a year and is underselling Canadian producers in the West European market. Mr. V. C. Wansbrough, managing director of the Canadian Metal Mining Association, pointed out that Russia had reached a position where she was ready to move into the world's mineral markets in a big way and undercut Canada's export position. In the last two or three years some minerals, including aluminium, of Soviet *bloc* origin had periodically come on to western markets and were invariably cheaper than western products. While it was appreciated, he said, that Russia needed more foreign exchange from time to time and economic agression was not involved, nevertheless Russia could carry the practice still further "as a matter of deliberate policy and as an aggressive attack on our markets".

EUROPE USES MORE GAS

The O.E.E.C. Gas Committee in its 1960 report entitled "Gas in Europe" provides some useful data on the growing use of manufactured and natural gas supplies within the member countries of the Organization. While overall energy requirements have been expanding by about 4 per cent per annum during the last decade, demand for gas has been rising on an average of about 6 per cent per annum despite the adverse effect of the slight economic recession of the late 1950's. Although at the present time the proportion of total energy requirements supplied by manufactured and natural gas is still below 10 per cent, it must be borne in mind that as gas is one of the higher forms of energy, its use is mainly to produce heat, and therefore this fuel impinges directly on traditional coal markets.

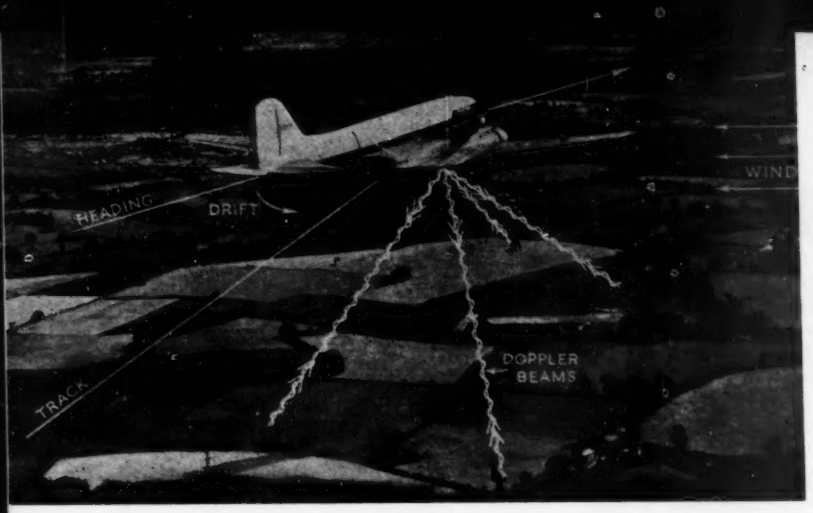
There is, however, a steady market for good gas coals within Europe but unfortunately stocks of these are being rapidly depleted and the report reveals a tendency for total gasification plants to use small coals which cannot readily be converted into coke. This is a highly significant development and the recently opened Lurgi high pressure gasification plant in Fifeshire may well be a pointer to subsequent developments in this field. This £6,500,000 project is the first of its kind in Britain and among the first half-dozen in the world. It is currently producing some 6,000,000 cu. ft. of gas a day and this will increase to five times this figure by 1962 when the plant's annual coal consumption will be nearly 500,000 tons. Reference is also made to the significant increase in the utilization of refinery tail gas.

The committee emphasize that there is still some uncertainty about the amount of natural gas that will be available in Europe within the next few years, and reveals even greater uncertainty about the more distant future. However, they conclude, it is technically possible to produce a yearly output from the Sahara deposits of 20,000,000,000 cu. metres at 9,000 kcal., of which some 75 per cent would be available for export to Europe.

Taking all these factors into consideration, it would seem that the various coal industries of Europe are going to have to face severe competition for some considerable time to come.

Aerial Survey—I

Recent Advances



A Hunting Surveys aircraft in flight, showing relative disposition of beams from the Doppler Navigator, the wind direction, and the heading, drift angle and track of the aeroplane

THE simplest, quickest and cheapest use of air photography is examination of the photo prints themselves which, built up into a photo mosaic, give an immediate picture of the surface structure and geology of an area; more detailed study of selected pairs of photo prints under the stereoscope by a geologist with knowledge of photo interpretation will yield much further information. To the engineer in charge of operations in an area which is very rugged or difficult of access, the mosaic can be of assistance in the choice of route to a centre of interest, and may suggest the best line for a road or railway. Subsequently, small scale maps for reconnaissance, and large scale plans for engineering purposes will be required from the air photography.

Maps and plans produced by air survey methods are the end product of a series of distinct though closely related operations. An aircraft must be positioned with accuracy to allow a precision camera to photograph a specified area. The negatives must be printed on to paper, and on to glass for the plotting process. Geodetic control, to provide scale for the air photographs and to establish their exact position on the earth's surface, must be established. From the data available glass positives of overlapping exposures, in correct orientation and relative position, must be set up in the stereo-plotting machines on which the maps are to be made.

Over recent years research and development has been proceeding with two aims in view: to produce maps of greater accuracy, and to speed up and reduce the cost of the operation. The Ninth International Congress of Photogrammetry, held in London during September, 1960, showed ample evidence of considerable advances. These developments are discussed below, under appropriate operation headings.

Flying

Survey flying, either for mapping or geophysical purposes, has been made simpler and more accurate by the use of the Doppler navigator; reflying of wrongly positioned lines has been almost eliminated, and the rate of strike has been increased with consequent economic advantages.

The Doppler navigator is a self-contained airborne electronic instrument which enables the ground speed and drift of an aircraft to be accurately determined without the aid of any ground installations at all. When the vectors of ground speed, drift, and aircraft heading are processed in a computer the co-ordinate position of the aircraft can be continuously presented to the pilot and navigator, and the recorded data can be used at any time to re-establish the flight line, either in the air or in the laboratory.

Doppler equipment of accuracy is the type AD.2000 made by the Marconi's Wireless Telegraph Co. Ltd., which measures ground speed to 0.1 per cent, and drift to 0.1 deg. and, when used with the Ground Position Indicator Mark IV, along and across track co-ordinates are presented to the accuracy of 0.15 per cent and 1.5 deg. respectively. The across track component is much the less accurate because of the effect of heading reference (compass) errors, but this deficiency can be overcome by suitable flying and reduction techniques.

Cameras

The accuracy limits and the detail recorded on the final map are dependent upon the quality of the photographs obtained, and therefore on the standard of the camera used. Wild Ltd., Switzerland, are the designers and manufacturers of excellent air survey camera lenses. For a number of years their 6 in. wide angle Aviogon lens, which covers 90 deg. across the diagonals of a 9 in. x 9 in. format and gives high resolution with virtually no distortion, has been a standard optical system for first quality survey photography. The latest Wild lens, the Super Aviogon, has a focal length of 3.5 in. for the same 9 in. x 9 in. format and therefore covers 120 deg. across the diagonals.

The practical virtue of this lens is that it enables an aircraft flying at a given height to obtain photographs of a

The 3 ft. aerial of the Marconi AD 2,000 Doppler Navigator. The radome has been removed

Aerial Topographic Surveying for Mining

The mining engineer who aims to exploit a new concession, or an extension to an old concession, wants available for study the clearest and most detailed possible picture of the area in which he is interested; and he wants it quickly. Modern air survey has much to offer in this context, and the purpose of this article is to discuss some recent developments which are widening its value to the mining geologist and engineer. The following article, the first of two instalments, deals with the practice of survey flying, the cameras and processing methods used. The subsequent instalment will deal chiefly with airborne methods of obtaining ground control, and the machines used to accomplish this purpose. Throughout the two articles, particular reference is paid to the mining industry

By J. R. Hall

Research Officer, Hunting Surveys Ltd.

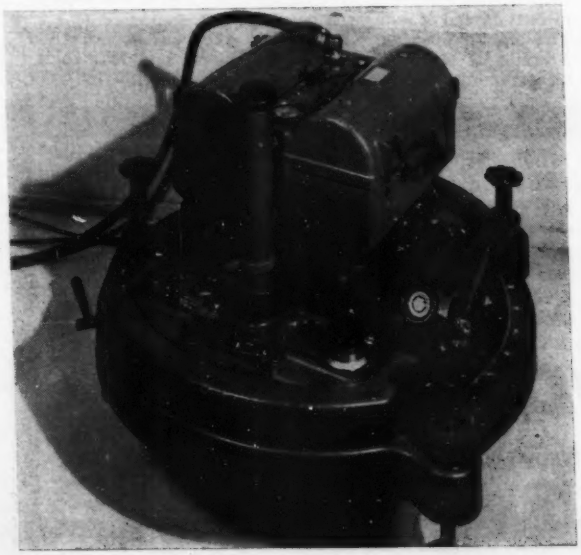
larger area of country at smaller contact scale than was previously possible with the 6 in. lens. Thus from 25,000 ft. with a conventional piston engined aircraft the Super Aviogon camera will cover a strip of country for which the 6 in. camera would have required flight at 42,000 ft., to attain which a special aircraft with the very expensive complications of turbine engines and pressurization for the crew would be needed. In short, the very wide angle covered by this camera permits larger areas of country to be covered by conventional aircraft in a given time and for a given number of exposures, and so leads to more economical small scale basic mapping.

The RMK 15/23 camera made by Zeiss Aerotopograph of Munich is another excellent camera because its shutter is capable of accurate exposures of 1/1,000 sec. The camera which has a 9 in. x 9 in. format and is fitted with the Zeiss 6 in. Pleogon lens, is particularly useful for very large scale photography from low altitudes because the very fast shutter speed available cuts out the distorting effect of ground movement on the negative. As a result, accurate large scale engineering plans of the order of 40 ft. per in. or even larger, can be produced from photography taken from conventional aircraft.

Sensitive Materials

To make the utmost use of the tremendous capabilities of the modern air survey camera optical systems, film is required which will give extremely high resolution. In general the higher the resolution the slower the material, but in air survey a compromise has to be reached; the film must be of a quality to give very high resolution, but its speed must be such that a sufficiently short exposure can be used to eliminate image movement due to vibration or forward motion of the aircraft. A number of films with this range of properties is now available, and these can be used to particular advantage over well lit terrain. Two representative products are Ilford's High Resolution film and Kodak's Panatomic "X".

The Wild RC 5 survey camera with 6 in. wide angle lens. Tilt and drift setting controls are shown



Processing

Even when photographs are taken in perfect weather conditions it is not always possible to get the full advantage of good resolution on to paper or glass by conventional contact printing. This is due to the contrast in the negative itself, and the fact that for best small detail reproduction a high contrast postive material is required. For example,

The Rank-Cintel electronic printer with 9 in. by 9 in. film in position

rugged terrain in strong light will show dense shadows and brilliantly lit peaks; again, a countryside photographed below cumulus cloud on a bright sunny day will show a tremendous range of negative density between the brightly lit areas and those parts obscured by cloud shadow. The modern lens will record good detail on the negative in both the shadows and the highlights but conventional printing will produce a picture with detail in the highlights and featureless black shadows, or it will show detail in the shadows but will lose the finer points in the brightly lit areas.

A recent invention called the electronic printer, such as that produced by Rank-Cintel Ltd., automatically controls the printing time of each part of the negative.

In this equipment a spot of light on a cathode ray tube is focused on to and scans the negative, above which is located the positive material such as bromide paper or a sensitive glass plate. A photomultiplier tube at the top of the apparatus measures the light coming through the combination of negative and positive material and by a feed back loop controls the spot brightness of the cathode ray tube below. The purpose of the photomultiplier tube is to receive a constant amount of light and by so doing to produce an even print. Because the spot size is approximately 0.1 in. in dia. fine detail contrast is not lost, and density control applies to the larger areas such as cloud shadows.

Prints and glass positives (known as diapositives) of even density make subsequent plotting in the photogrammetric stereo plotting machines easier and more accurate. Furthermore, because the printing exposure is automatically controlled, the prints can be produced more quickly and this can be an important economic factor.

Utilization of Cobalt Powders

IN recent years great progress has been made in the sintered hard metal industry which, at the present time, is one of the most important branches of powder metallurgy. This field of application is presented as one of the rare cases in which sintered products are superior to cast products. These points are emphasized in a short review on the uses of cobalt powders that has appeared recently in the March, 1961, issue of *Cobalt*, the quarterly journal published by the Cobalt Information Centre.

Cemented carbides consist essentially of a hard constituent with a high melting point, and of a metal binder with a lower melting point, such as cobalt. These different materials are subjected to a grinding and mixing operation, generally in a liquid, for periods of up to several days. After drying, sieving and the addition of a lubricant, the mixture is moulded under pressure, and presintered at a temperature which depends on the composition and which is generally between 700 deg. C. and 1,100 deg. C. The body is then sufficiently strong to be machined to its final shape.

The sintering process, in the simplest case of a WC-Co alloy, can be outlined as follows. During heating, the carbide partially dissolves in the cobalt, forming a liquid phase with a low melting point which wets the solid WC grains and penetrates into the pores of the aggregate. On cooling, the dissolved WC precipitates, and a carbide skeleton low in Co and enclosed in a ductile matrix of the binder, results.

Up till now, in spite of many attempts to substitute another metal, cobalt is the only binder that gives complete satisfaction when used with WC alone or combined with TiC, TaC, or NbC. The amount of binder incorporated in hard metals varies greatly, according to the type of application envisaged. Generally speaking, it can be said that increasing the percentage of cobalt increases the ductility and toughness as well as the bending, compressive and fatigue strengths, but decreases the hardness and abrasion resistance.

Some of the more important applications of cemented carbides are; drawing dies, mining equipment such as rotating and percussion drills, instruments and machine parts used in powder metallurgy and kindred industries, cutting tools and projectiles and diamond tools. In the case of diamond tools, cemented carbides provide copper base alloys permitting low temperature sintering, iron and nickel base alloys for work at higher temperatures, molybdenum or tungsten alloys which must be sintered at even higher temperatures, and WC-Co or WC-TiC-Co cemented carbides sintered at between 1,300 deg. C. and 1,500 deg. C.

In calling for special production techniques to prevent graphitization of the diamond, the cemented carbides offer certain important advantages including the strong binding of the diamonds to the matrix, a high hardness and excellent abrasion resistance of the binder, and matching thermal expansion coefficients of the carbides and the diamonds that maintain strong binding at high temperatures. In addition, the cemented carbides have high temperature applications.

A further use of cobalt powders is in the manufacture of permanent magnets. The production of small magnets with complicated shapes is usually carried out by powder metallurgy methods. The agglomeration is usually effected either by means of a synthetic binder or by sintering.

Cobalt powders also find applications in high temperature alloys, stellites and hardfacing alloys.

Major Precambrian Boundaries and Ore Deposits — II

IF a broad pattern exists on the North American continent between age-group boundaries and certain ore deposits some comparable relationship should be found in other Precambrian areas of the world. To some extent we are hampered by the rather limited and widely-spaced age determinations available. Boundaries between Archaean nuclei and younger Precambrian are known only where they are clearly shown by structural or lithological changes. Such evidence as we have, however, does suggest that the same pattern is repeated, at least in regard to bedded iron and uraniferous conglomerates, in major Precambrian areas in the following places :

South America

In Brazil the well-known iron deposits (and associated manganese) of Central Minas Gerais lie close to the base of a series of sediments that overlie a basement on which dates of about 2,500,000,000 years have been obtained. The iron formation itself (Itabirite) and the beds with which it is associated, bear similarities to the Proterozoic iron formations referred to in North America and, from the limited information available, the date of deposition and relation to the Archaean basement are similar. The gneisses lying between the iron ranges and the east coast show a foliation with prevailing easterly dips, give younger ages from such determinations as have been carried out, and generally may be compared to the gneisses of the Grenville tectonic province in Canada.

Reference has already been made to quartz-pebble conglomerates carrying gold and some uranium which lie in approximately the same structural position as the iron beds but on their northeasterly extension into Bahia State.

In Venezuela the iron formations and manganiferous beds south of the Orinoco River appear to be of the same approximate age as those referred to in Brazil and may define the north boundary of the same Archaean continental nucleus.

West Africa

In the western part of the north half of Africa bedded iron formations, containing some very high-grade concentrations, are found in Mauritania, Liberia and Sierra Leone. These appear to be of middle Precambrian age and lie unconformably on an older gneissic complex. A limited number of age determinations indicate that this complex is Archaean but an actual boundary between this and younger tectonic provinces of Proterozoic age remains to be proved except locally. If, as seems possible, a continuity of boundary can be shown, like that in the eastern part of the Canadian Shield, it might be valuable, not only in linking the several important iron deposits of this type now being mined or developed in West Africa, but as a guide in the search for sulphide deposits of other metals.

Evidence is accumulating (e.g. recent papers by B. B. Brock and the Provisional Structural Map of Africa by R. Furon) that similar boundaries in other Precambrian areas of the continent have greater continuity than was previously recognized, with corresponding economic implications.

India

In India there have been enough age determinations (by Holmes, Krishnan and others) to show an old Archaean nucleus centred on Mysore and bounded by younger folded "provinces" on the east, north and possibly also on the west. The iron formations of Singhbhum, although involved in much younger folding (dated at about 800,000,000 years) lie near the base of a series which would, it is believed, be classed as Proterozoic in North America. When other occurrences of banded iron formation of "ferruginous quartzite" are plotted they fall, to a significant extent, near the assumed boundary between the central nucleus and the surrounding younger tectonic provinces in a roughly triangular pattern within the triangle of the Indian peninsula itself.

A second Archaean nucleus is suggested (but not proved) in north-west India in the State of Rajasthan bounded on the west by the younger folded sediments of the Aravalli and Delhi formations (Heron). The author was interested to see radioactive quartz-pebble conglomerates (so far not of commercial grade), interbedded with quartzites, near the base of the sediments where they overlie the gneissic basement, i.e., in a corresponding position to the uranium-bearing conglomerates at Blind River, Ontario. Banded iron formation does not appear to be developed here although some iron beds are reported further north.

The only current copper-producing mine in India, at Ghatsila, lies in a sedimentary-volcanic belt not far north of the Singhbhum iron beds. The only present producer of lead and zinc in India, at Zawar, occurs within a few miles of the boundary between younger Delhi beds and an older gneiss mentioned in the previous paragraph. Here again, as in Canada, the relative propinquity of base metal sulphide deposits to the boundary between Archaean basement nuclei and folded younger Precambrian is something that appears to be more than a coincidence.

Conclusion

The beds immediately overlying, and bordering, the ancient Archaean basement nuclei are of unusual economic importance being the source of :— (1) Seventy-five per cent of North American iron production, the major part of that of South America, a growing proportion of African iron output and probably over 80 per cent of Indian production. (2) Thirty-six per cent of the estimated uranium

This article concludes our reproduction of extracts from Mr. Duncan R. Derry's presidential address to the Society of Economic Geologists at their Annual Meeting in Denver last October. The full text of the address will appear in a forthcoming issue of "Economic Geology". The extracts here presented examine similarities in the Precambrian areas of continents other than North America. Mr. Derry, who is now consulting privately, was until recently vice-president (exploration) of the Rio Tinto Mining Company of Canada Ltd.

production of the Western World for 1960. In addition, the distribution of base metal sulphide deposits, at least in the Canadian Shield, shows an intriguing spatial relationship to sections of the boundary between Archaean and Proterozoic.

This boundary is not everywhere easily traced, especially where involved in later folding and alteration, and the use of radioactive dating is becoming an important complement to structural mapping, not only in clarifying the broad patterns of age divisions in Precambrian shields, but in the study of the distribution of the ore deposits mentioned. It is likely to be employed to an increasing extent, particularly in Precambrian areas where tropical weathering and vegetation tend to obscure the detailed structures. Preliminary evidence indicates that the same sort of relationship of ore deposits to age boundaries exists in most of the major Precambrian areas of the world and the definition of such boundaries, particularly where not obvious from conventional mapping, may permit a concentration of effort in the search for new ore deposits to more confined and favourable areas.

The boundary of the "Keewatin nucleus" of the Canadian Shield is probably known in more detail than any similar boundary because of the combination of glaciation rock exposures, negligible disturbance since Precambrian times and the relatively concentrated study over the past few years including considerable use of radioactive dating. This seems to be an opportunity for the co-ordination of, on the one hand, the experience gained in the study of patterns in the North American Precambrian and, on the other, the structural information assembled to date by geologists in some other Precambrian areas of the world.

Since such studies must, of necessity, be carried out over very large areas crossing (especially in Africa) the boundaries of several independent nations, it would be logical for the medium of such co-operation to be one of the technical aid programmes of UNO or UNESCO. Technical advice and help might be provided by such international organizations as the Society of Economic Geologists and relevant committees of the International Geological Congress.

LOW PRESSURE STOWING WITH A SCREW COMPRESSOR

PNEUMATIC stowing entails the packing of material into the available waste areas underground, generally into the wastes formed by coal extraction from longwall faces. The system also has been used in metalliferous mines. Indeed, stowing by pneumatic power has been carried out for many years with good results in mines throughout the world.

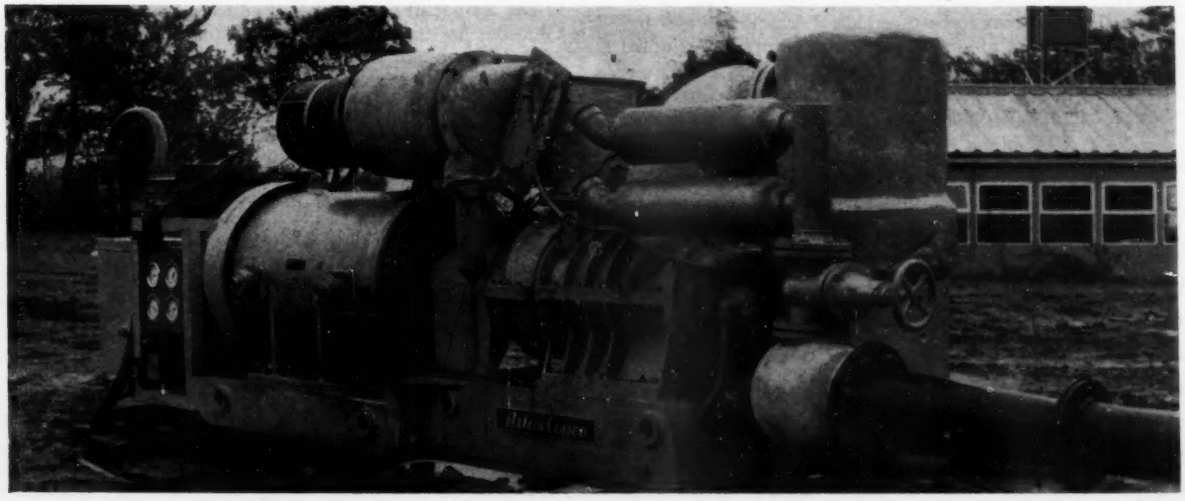
The method normally employed is to introduce the dirt into a compressed air line via a stowing machine—a type of rotary valve—the compressed air being obtained from the air mains emanating from a compressor on surface.

There are, however, certain disadvantages to this system. Energy losses in the compressed air line between the surface and the stowing machine are high, and unless special large diameter mains are provided the system frequently tends to be starved of air. Further, the cost of compressed air when high capacity surface compressors are used is very considerable, and depreciation charges for plant, including shaft and underground air mains, considerable.

In the interest of greater economy and efficiency, the British N.C.B. have been experimenting over the past two years with a low pressure stowing method. In this method the stowing machine is placed at the face of the roadhead, or alternatively in the roadway very near the face, (thus reducing the length and complexity of the stowing column), and air is supplied by an inbye compressor delivering about 2,000 c.f.m. at a pressure sufficient to overcome the back pressure of a loaded stowing installation. Experience has shown that a pressure of 15 p.s.i., peaking up to 20 p.s.i., will enable the compressor to be used with a stowing machine situated as described, and to give the stowing performance normally associated with the higher pressure installations more generally used.

The inbye compressor employed for this work has been the subject of considerable research and experiment by the Coal Board. Until recently turbo-blowers, sliding vane compressors and lobe-type blowers have been used with varying degrees of success. Probably the most successful unit has been the lobe-type blower, although when this is used as a single stage machine a maximum air pressure of 9-10 p.s.i. gauge only is obtainable. This pressure imposes limits on the geometry of the stowing pipe line and/or the quantity of stowing material which can be handled.

The Atlas Copco U 18 screw compressor on its low pressure stowing trials at Penallta Colliery



At right, alongside, colliery dirt being rejected from the stowing pipe

Below, on this page, the type of dirt that can be handled by the U 18 working in conjunction either with a Markham or Brieden stowing machine

Further, at pressures approaching double figures, this type of blower is uneconomical in power demand. In fact, a 100 h.p. motor is required to provide 2,000 c.f.m. at 9 p.s.i. from this machine.

The Board decided that if low pressure stowing were to be used to the best advantage it was necessary to have more pressure available to enable stowing comparable in performance with that of the higher pressure systems to be carried out.

They narrowed down their requirements to the following. They wanted a machine that was compact and of suitable size for working inbye; that demanded a relatively low horsepower—about 150; that had a free air delivery of 2,250 c.f.m. at 15 p.s.i.; and that was air cooled. The intention was to try out such a compressor with both the Markham Direct-On-Face and the Brieden KZS 50 stowing machines.

The U 18 Unit

The first machine answering these requirements to go on trial was one of the Atlas Copco screw compressor range, the U 18. For many years Atlas Copco have manufactured screw compressors under licence from Lysholm patents. Generally speaking, they have standardized on a few basic single stage units. The relative capacities of these units have been selected in such a way that one compressor can be run as the low pressure stage and another as the high pressure stage in a two stage machine. One of these basic units is the U 18 machine, suitably modified for power stowing over face lengths which correspond to the average adopted for machine mining in Britain.

The U 18, connected to a Brieden KZS 50 stower, began its trials at Penallta Colliery, near Cardiff, last September. Standard 6 in. bore stowing pipe was used, total length being 180 ft. plus one right angle bend. Under these conditions a throw of up to 30 yd. was obtained when stowing at the rate of 80 tons per hour producing a pack having a density of 83 lbs. per cu. ft.

This performance was obtained in spite of the fact that the resistance of the stowing line, before the introduction of the dirt, caused a back pressure of 10 p.s.i. to be created.

Modifications resulting from noise level tests resulted in comparatively low decibel readings. In plain terms, one can stand within 5-10 ft. of the compressor and talk normally. Both intake and discharge silencers were fitted. The compressor drive was arranged direct from the 150 h.p. Bruce Peebles electric motor to the female rotor, which therefore rotates at motor speed (3,000 r.p.m.). The male rotor is consequently driven at 4,500 r.p.m., there being four lobes on the male rotor and six recesses in the female rotor. Thanks to the good balance, small dimensions and compactness inherent in screw compressors, the machine can be mounted on a skid underframe—at Penallta it was so mounted—and is consequently mobile.

After successfully completing its trials at Penallta the U 18, with a stower, was transported to Cadley Hill Colliery, Derbyshire, and installed inbye. Here on a longwall production face the machine operated most successfully for a trial period of three months after which it was retained by the colliery for continued stowing operation.

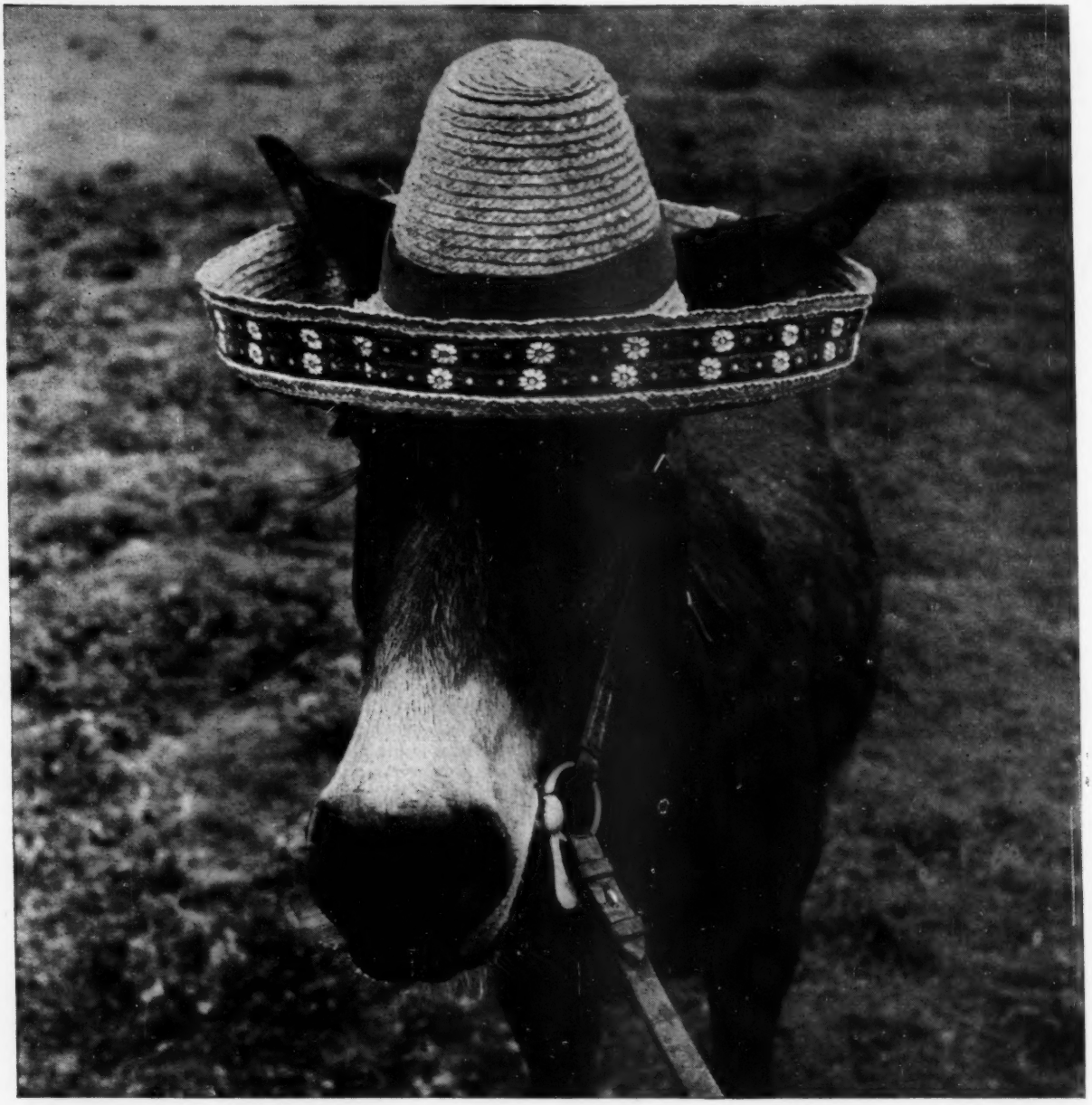
The face, 120 yd. in length, is completely stowed every two days and the present maximum length of pipe through which it is necessary to operate is 100 yd. although this is shortly to be increased, in the next panel to be worked to 120 yd. The rate of advance is 5 ft. and the height of the seam which is being worked varies between 6 ft. and 7 ft. The stowing time totals 4 hours per day. Thus, in each complete two-day cycle 465 cu. yd. of dirt are stowed.

Advantages Underground

The screw compressor has certain very definite advantages when on underground service. Having few moving parts, it requires the least possible maintenance and infrequent overhauls. The two rotors never touch, therefore no oil is required in the compression space. Completely oil-free air is delivered and there is no risk of oil fires. Experience has proved that screw compressors are largely unaffected by airborne grit particles in the intake air. Because there is always a clearance between the two rotors and the casing, and because the rotors maintain a rolling motion relative to each other, filtering is no great problem even under such adverse conditions as prevail underground.

In pneumatic stowing, the actual blowing time is only a fairly small proportion of the total time—generally one-third, compared with two-thirds spent on preparing the face for stowing. Even if this proportion amounts to one-half, as it may in a good installation, the air is only required for 50 per cent of the stowing time at the most.

The production of airborne dust, caused by the action of pneumatic stowing, is an operational difficulty. Among the factors, however, which influence the quantity of dust, is the quantity of compressed air used while stowing. Low pressure stowing conditions enable relatively low air quantities to be used, so assisting in the constant struggle to keep airborne dust concentrations caused by stowing, down as low as is possible.



¡SALUD, AMIGO! Amigo is not dead — But he will never come back to carry ore-crusher components to the mountains of South America as he did 100 years ago ■ You do not remember those days. Mining machinery was indeed taken up to the mountains by mule. Amigo was a wonderful mule ■ Today, it is different but it is also the same (as the French say). There is no mule, but equipment is carried by river or even in an amphibian aircraft, to a manganese treatment plant in British Guiana ■ In the old days, the equipment was sent by Fraser & Chalmers of England. Today it still comes from Fraser & Chalmers for they are now part of the G.E.C. organization ■ All the same, people have not forgotten Amigo ■ He symbolizes the long friendship of many people.

G.E.C. has supplied to the African Manganese Co. (Mines Management) Ltd. in British Guiana: Manganese Treatment Plant in two parallel units of 125 tons per hour each: The Power Station (with Diesel capacity of 2725 kW); The Pumping Station (with installed power of 1275 h.p.); Conveyors for loading ore trains.

RELY ON THE EXPERIENCE OF G.E.C.

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361

Machinery and Equipment

Plastics for Rock Impregnation

The preparation of satisfactory thin sections of certain friable rocks and sediments for microscopic examination presents the geologist with many problems, not least of which is the break down of the specimen due to its brittleness and incoherence. Recent experiments at the Royal School of Mines have shown, however, that this problem can be simply and inexpensively overcome by impregnating the specimen, prior to sectioning, with a polyester resin—Bakelite Resin DSR. 19098.

The method adopted is to cut, where possible, a 3-4 mm. thick section from the specimen. If the material is so incoherent that it is considered unwise to attempt to cut a slice, the whole lump should be impregnated with resin and treated after hardening as a normal hard rock—the slice being removed with a diamond saw.

The sample is first thoroughly dried at 105 deg. C. to avoid the possible formation of water vapour bubbles, and then immersed in the polyester resin : expendable metal containers are quite suitable for holding the resin. If the sample is large, it is not necessary to immerse it completely, since the resin will rise several centimetres by capilliary action.

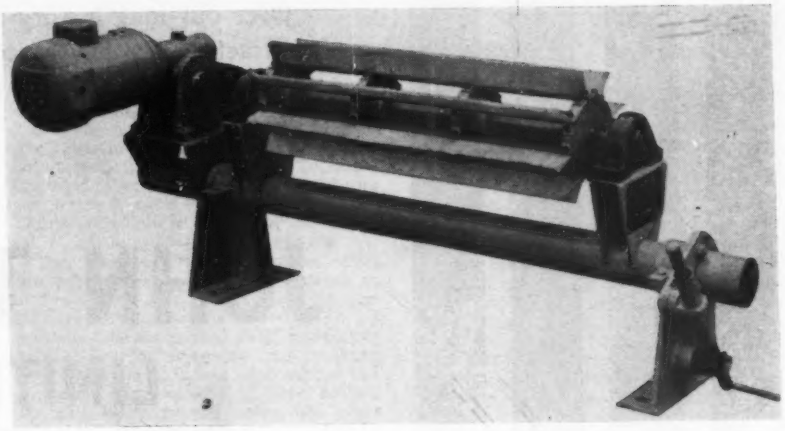
The sample and resin are heated to about 75 deg. C. in an ordinary laboratory oven and held at this temperature for about 12 hours, by which time the resin will have acquired a treacly or even jelly-like consistency. The temperature is then raised to about 125 deg. C. and held for a further 12-24 hours, when the resin should have acquired a tough rubbery texture, and on cooling at room temperature should be hard enough to resist indentation with a mounting needle. After removal from the container, the sample is ready for sectioning in the usual way.

This technique has yielded good sections including a loess from Kent, a Pleistocene chalky solifluction sludge and a variety of recent sands, silts and clays from the Wash. Previously, no conventional technique had been found capable of yielding sections from such materials and, in many cases, it has been possible to view certain materials under the microscope for the first time.

CONVEYOR BELT NOTES

Claimed to be the most effective and economical method in use the K.A.M. unit by the Industrial Division of The Kleen-e-ze Brush Co. Ltd., is stated to be capable of dealing with all materials and conditions of conveyor belt cleaning.

The standard K.A.M. unit is complete with a totally enclosed English Electric motor 400/450 volts or 500/550 volts, 3 phase, 50 cycles and flameproof if necessary, but other voltages are available to meet local conditions. Similarly, the h.p. varies in relation to belt widths, i.e., for belts up to 26 in. wide—½ h.p. motor, 27 in. to 47 in. wide—1 h.p. motor, 48 in. wide and over—1½ h.p. and 2 h.p. motors. A suitable worm reduction gearbox with Renold coupling is provided to give optimum brush speed in relation to the existing belt speed and materials handled



The K.A.M. unit by The Kleen-e-ze Brush Co. Ltd.

i.e. coal, coke, slurry, iron ore, sinter, etc. A screw adjusting feature provides instant micro-adjustment of the brush. The supporting pedestals are made to fit normal conveyor structures using four bolts only.

The compact nature of the nylon filling in the brush rotor plus the paddle action of the brush, give efficient cleaning and long life with little or no attention, without damage to expensive belting. The open assembly prevents clogging and the brush is in fact self-cleaning. After the initial installation, the brush parts (eight metal backed Kezstrip brushes) only need be replaced. The replacement brush segments can be rapidly assembled on site. When necessary anti-static features can be incorporated.

*

A new woven carcass rubber conveyor belt, which withstands abuse far beyond conventional ply-type belting, was introduced recently by Goodyear.

Earmarked for long life in rugged industrial and hard rock mining service, the new product, called Industrial Uniflo, was announced by The Goodyear Tyre and Rubber Co., United States. It is claimed that the new belt offers previously unknown resistance to cuts and tears.

The new belting line is especially adaptable for iron ore and hard rock mining because of its capacity to be vulcanized into an endless unit in the field. The Uniflo belt is the first woven carcass belt to successfully offer this capacity. Conventional woven carcass belts are joined at the end with mechanical fasteners or hooks that must be operated under reduced tension. Vulcanized splicing of Uniflo was made possible by adapting Goodyear's time-proven compass uniplane splice to this new type of uniplane carcass.

The new product is produced on America's first- high-speed automated belt calendering machine, a two-story, $1,600,000 giant installed at Goodyear's Plant II in Akron. The huge, electronically controlled unit utilizes X-ray eyes to ensure uniformity and quality. Produced in continuous lengths without cover seams, Uniflo features a carcass of nylon reinforced cotton yarn woven into a special interlocking complex.

Thousands of rubber rivets penetrate deep into the woven carcass to ensure maximum cover adhesion. Without the use of a breaker the new product offers unusual resistance to cover separation, even under most severe usage.

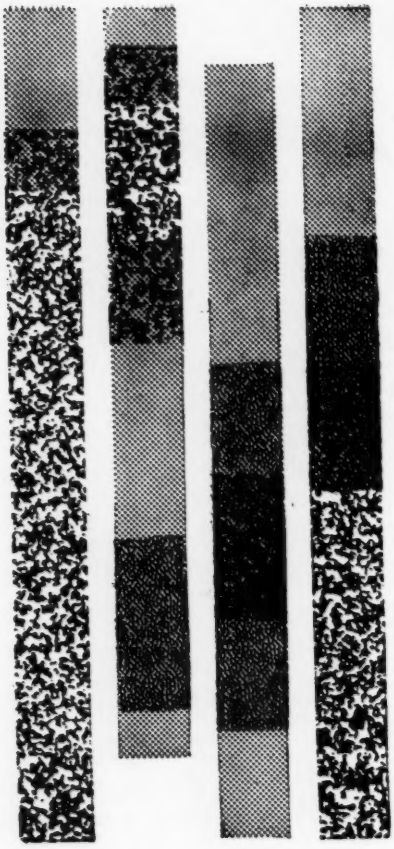
The new conveyor material has been described as having ten times the rip resistance of conventional cotton duck belts and three times that of the best cotton-nylon ply belts of comparable strength. It also provides built-in protection against internal ruptures resulting from trapped lumps and excessive pulley build-up.

Built-in impact resistance, excellent fastener holding qualities, outstanding troughing and tracking properties and better resistance to edge wear are other advantages of the new belting. Goodyear commenced developing a woven carcass belt specifically for hard rock and industrial service after its Uniflo showed such outstanding advantages in underground coal mining service. Goodyear also expects Uniflo to find wide application in such operations as the crushed stone, sand and gravel, steel, cement and foundry industries. The Goodyear Uniflo is at present only marketed in the United States.

NEW PUMP SERIES

A new line of electric submersible pumps, lightweight and compact, is to be introduced into Canada during 1961 by Flygt Canada Ltd. The first model of the new series, BIBO 3, is now available, according to a report in *The Northern Miner*.

To be known as the BIBO series, our contemporary points out that the new pumps were developed upon experience gained by the company's 12 years in the submersible pump field, and are intended to supplement rather than replace the Flygt pumps. Basically similar in design to the Flygt line, pumps in the new series are about half the size and weight, while having equal or greater capacity and



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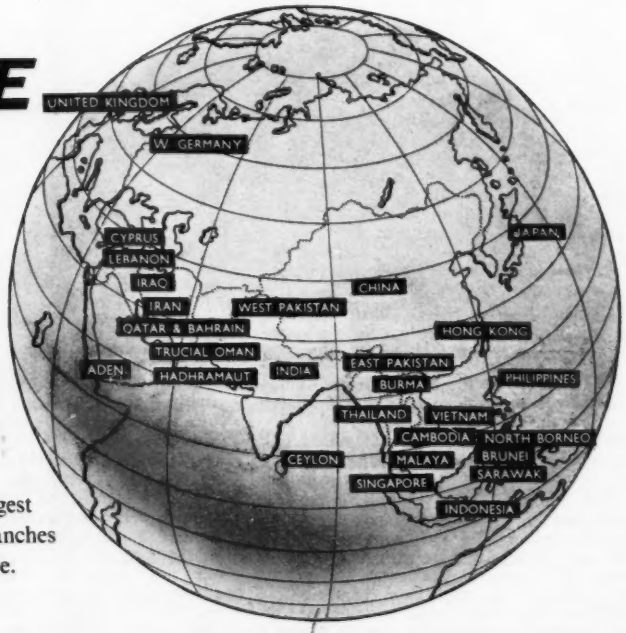

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slightly lower heads. In addition, servicing and repairs of the BIBO pumps has been simplified and operating costs reduced. The initial cost of the new pumps will also be less.

The first of the new line, BIBO 3 corresponds to the Flygt model B-80 3 in. pump, which will continue to be sold as a high-head pump. Others in the new series will be introduced from time to time. Eventually BIBO models will duplicate all Flygt pump sizes.

The fully submersible BIBO 3 is powered by a five h.p., three phase electric motor sealed into the rugged aluminium casing. It weighs 88 lb., is 22 in. high and has an overall dia. including the discharge outlet, of 16 in., as compared to 186 lb., 26 in. and 18 in. for the Flygt B-80 models. Two interchangeable impellers give it a maximum head of 110 ft. and a maximum capacity of 350 g.p.m.

QUICK CHANGE PINS FOR RIPPERS

A new two-piece quick change pinning device for securing tips on Caterpillar No. 8 and No. 9 rippers can be installed or removed within one minute, using only simple hand tools. This device is now fitted to rippers manufactured at Caterpillar Tractor Co. Ltd.'s Newcastle plant.

In addition to the ease of installation and removal, the new pins are claimed to be virtually unbreakable, having more than twice the strength of previous rivets. The high strength results from through-hardening of the alloy steel forgings.

Each pin semi-circular in dia., is bent slightly at the centre to achieve the locking effect, and is flanged at each end. Pins are installed back-to-back. Because of the inherent wedging action, they are installed or removed only one at a time.

The new pins will fit all Caterpillar ripper shanks now in the field. Elongated holes are required in Ripper tips used with the new units, however, and this change is incorporated in all tips now being produced. The pins, an exclusive Caterpillar development, are covered by patent applications on file in Britain and other countries.

DETECTING DIAMONDS AND METALS

A novel portable device for detecting diamonds, other gem-stones and scarce metals in soil samples has been developed. News of the equipment originally appeared in a *Tass* report.

Tests carried out with the new equipment are said to have shown that it is exceptionally efficient in operation, and no failures in detection of even very small industrial diamonds have so far been encountered.

At the same time, the equipment is fully portable and is said to be exceptionally cheap to operate. The operation of the system depends on the use of radioisotopes. This eliminates the need for cumbersome X-ray equipment — the only previously available fully efficient method of ensuring 100 per cent efficiency in diamond detection in soil samples. The radioisotope equipment used depends for its operation on the use of a radioactive source of 0.3 to 0.5 grm. of thulium 170.

The system possesses the additional advantage that it can readily be adapted for the detection of other types of gems, and will even identify which types of gem-stones are being encountered. in the soil sample, or on a larger scale for the recognition of the metal-containing elements of metal-bearing ores. In the latter case, it can be adapted so that the detection equipment will both carry out measurement of the amounts of metal present and, if required, operate automatic control systems for the ore processing.

Equipment Digest

The first edition of Publication No. 52 was recently released by Keith Blackman Ltd. The pamphlet covers by description, drawings, photographs and capacity tables, the new range of Tornado-Cyclogal high efficiency dust collectors which are available in seven sizes, with normal rated duties from 160 to 42,500 cu. ft. of dust laden air per minute.

The Tornado-Cyclogal settler offers not only an extremely low resistance to airflow but also a high collection efficiency of particles down to 5 microns. It has proved itself completely satisfactory for screening and crushing, stripping and grinding operations and for grate furnaces and oil fired boilers. It may be employed, also, on plant where particles below 5 microns are involved, in these cases being employed as a primary dust collector. Such applications include hot blast cupola gases, blast furnace gas, generator gas, powdered coal boilers, flour lignite and cement dryers.

*

At an iron ore plant in the eastern United States, the optimum circulating load in the grinding circuit is maintained by the changes in the pressure reduction in a cyclone in the closed circuit. The signal is fed to a recorder-controller where output determines the setting of the ore feed recorder-controller, so that if the pressure decreases a lower feed rate is effected. The actual orefeed rate is sent to the orefeed recorder-controller by feedback from a resistance type load cell and a tacheometer on the feed belt. The combination of these represents the actual rate of material flow in the feed.

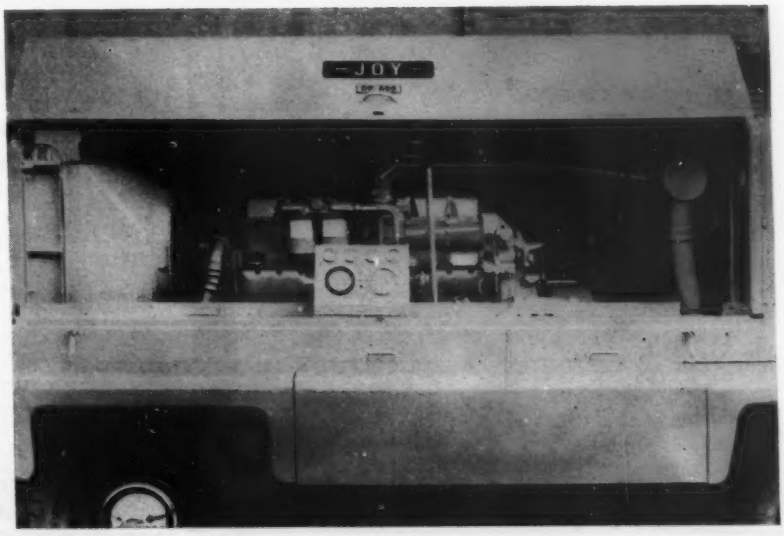
*

Worthington-Simpson have now applied their successful range of type "D" pumps to sump duties covering capacities up to 330 g.p.m. and heads up to 210 ft. depending on capacity. The newly developed units, which are intended for use in sumps up to 10 ft. deep, comprise a motor, of up to 10 h.p., mounted on a stool holding the main thrust bearing, a sole plate, suspension pipe, shafting, and a pump end from the existing "D" ranges. A feature in design is the fixture of the delivery pipe through the sole plate. This facilitates installation, prevents strain on pump delivery, and presents a neat arrangement. The pumps will handle a wide variety of acids, alkalies and slurries. Certain pumps are also designed to deal with liquids containing solids up to ½ in. dia., and viscous as well as clear liquids.

*

A new pneumatic flotation machine has been especially designed for phosphate flotation in the United States, in which aeration is obtained from multiple horizontal grids of air pipes in the machine. The unit is said to be advantageous in the flotation of silica from phosphate rock using cationic collectors.

Two Joy-Sullivan Airvane 600 c.f.m. portable air compressors have just been delivered to Norway. These machines are the first to be fitted with Rolls-Royce engines by Joy-Sullivan Ltd. at their Greenock factory and several modifications have been made in anticipation of the severe climatic conditions under which the compressors will work. The engines are Rolls-Royce C6 NFL six-cylinder 170 h.p. diesels, fitted with special cold-start boosters to facilitate starting in temperatures of −20 deg. F. or below. A special air drying container has also been incorporated in the compressor system to avoid freezing of pipelines due to trapped condensation



MINING MISCELLANY

During 1960 Norwegian metal exports rose by 13 per cent over the 1959 figure, to a total of 1,667,000,000 Kr. Exports included 143,000 tonnes of aluminium, 41,000 tonnes of copper, 29,000 tonnes of nickel and 625 tonnes of iron and steel. In addition, export of ores and metal waste was 15 per cent higher, at 151,000,000 Kr.; this total included 1,310,000 tonnes of iron ore, which was 290,000 tonnes above the 1959 figure.

★

A 10-year plan for national development in Chile envisages an annual output of 751,000 tons of copper from the larger mining companies, and the Paipote and Las Ventanas refineries. A further 158,000 tons are expected from medium and small mining groups. Production of iron ore in 1970 is estimated at 11,900,000 tons.

★

Venezuelan iron ore exports increased by 14.1 per cent in value in 1960, over the 1959 figure, amounting to SU.S.71,100,000 compared with SU.S.62,300,000.

★

The Sudanese Ministry for Mineral Reserves states that Abu Tulu iron ore reserves in Dar Miseriya, Kordofan Province have been estimated at some 35,000,000 tonnes. Examination of iron ore deposits in the Fedikwan area of the Red Sea Hills has been completed and a report issued. Examination of the copper reserves known as Jofrat En Nakas deposit in the south of Darfur Province has been completed, and report is to be issued soon. Sporadic copper reserves have been discovered in the Red Sea Hills. Reserves of lead deposits still under examination in the Kuttun district of Darfur Province are stated to be promising. Manganese and chrome ores have been found in the Ingasana area of Blue Nile Province, while asbestos and chrome deposits are being examined at Qala El Nahal.

★

The Japanese firms, Yawata Iron and Steel Co., and Fuji Iron and Steel Co. plan to purchase a total of 6,300,000 tonnes of iron ore from the Marcona Mining Co. of Peru. Shipments will start in 1963 and continue to 1969. Marcona are to order two vessels from the Japanese shipyards to transport the ore to Japan.

★

Output for the last quarter of 1960 from the new Konrad iron ore mine, situated between Salzgitter and Gifhorn in Lower Saxony, West Germany and owned by Erzbergbau Salzgitter AG have brought the company's total production for that period to 1,660,000 tonnes of ore — an equivalent of 6,630,000 annual tonnes.

A merger of associations representing the gold, base metals and petroleum industries of the Philippines is reported to be imminent. The associations are submitting a combined legislative programme to the President, calling for the enactment of draft laws now pending in the Senate, which would allow mining concerns to hold a financial interest in other similar concerns The Base Metals Association opposes the proposed repeal of a law permitting marginal industries to barter business against imports of foreign products, which frees them from the obligation of earning foreign exchange.

★

The Phalaborwe Mining Co. is working what is claimed to be one of the richest ore-bearing formations in the world, in the Letaba district, on the border area of South Africa. Copper ore, phosphorite and magnetite vermiculite and peroxidite were all found in this area. It was estimated that the Phalaborwe company could work 30,000 tons of copper ore daily, and produce 200 tons a day, while provision had been made for the daily production of 1,500-2,000 tons of magnetite (with iron content of over 60 per cent, and only 0.4 per cent titanium). In addition a further 150,000 tons of magnetite, with a higher titanium content could be exploited annually.

A three year expansion programme for the Yugoslav aluminium plant, Boris Kidric, at Kidricevo costing 10,000,000,000 dinars has been announced. Production is to be fully automatic and the French aluminium producer Péchiney to supply process licences and equipment under an agreement signed in 1958. The first phase of the programme will raise alumina capacity from its present level of 45,000 tonnes annually, to 90,000 tonnes, and the second phase will complete the programme by raising capacity to 145,000 tonnes annually.

★

It is reported that a mineral sands deposit has been found in the bed of the Tercero River in Cordoba, Argentine, containing 4 per cent monazite and 7 per cent heavy minerals, these including, in addition to ilmenite, zircon and rutile, some scheelite.

★

The Japanese firm Nippon Kokan Kaisha has sold 28½ tonnes of ferrochrome to China, the first export of ferroalloys from Japan to China for over two years.

★

Consolidated Mining and Smelting, in which Canadian Pacific Railway owns over 51 per cent of the shares, plans to have its Wedge copper mine, near Bathurst, New Brunswick producing at a daily rate of 750 tons by the end of 1961. The project will cost about $2,500,000.

★

The U.S. Department of the Interior states that its Office of Minerals Exploration has approved an exploration assistance contract with Roland F. Beers, Inc., to explore for nickel in Knox County, Me. This is the first such contract for work in Maine, and the first for nickel, the total cost of the work authorized under contract is estimated at $48,186, of which maximum government participation is $24,093.

★

The Australian Government is extending till June, 1968, the current taxation concessions for the mining and treatment of uranium ore.

★

The Compania Espanola de Minas de Rio Tinto will import into Spain 762 tonnes of copper concentrates from Eire.

★

A new project, Graton Tunnel, costing $8,400,000 is being undertaken by Cerro de Pasco Corporation, at the Casapalca mine in Peru, to permit extensive mining of silver, lead and zinc reserves which are not now worked because of underground flooding. The Graton project will consist of two tunnels, each seven miles long, and it is estimated that driving them will take about five years to complete.

★

Production began in January last at the Beryl Rose mine, near Darwin, 80 miles south of the Zambesi. The mine is operated by Morgan Mining (Pvt.), who are at present mining eluvial gravels. Good prospects are indicated for tantalite, and also for tin, and increased production of beryl. The first output of tantalite/tin concentrates produced by pilot plant are considered encouraging.

Wide Range of Mining Equipment

This week a representative of *The Mining Journal* saw demonstrated the wide range of mining equipment manufactured by Markham and Co. Ltd. during a visit to the company's works at Chesterfield. The factory covers approximately six acres, and is well equipped with modern, heavy and medium sized tools, lifting facilities and erection pits suitable for the very wide variety of work undertaken in the manufacture of some of the largest mechanical and fabricated engineering products.

The company has specialized for many years in the design and manufacture of colliery equipment, and for the past 30 years, in collaboration with Boving and Co. Ltd., in the manufacture of all types of water turbines and other equipment for hydro-electric schemes.

Following the recent agreement made between Demag A.G., Duisburg, Germany, and John Brown (S.E.N.D.) Ltd., Markhams are manufacturing a large part of the new wide flange beam mill for the South Durham Steel and Iron Co. Ltd.

Colliery Equipment

More than 200 steam and electric colliery winding engines, ranging from 500 to 5,000 h.p. have been manufactured and installed in this country and overseas. A project recently completed is that of design and manufacture of the surface machinery, including three friction winders, mine car circulation systems, cages and shaft equipment for the National Coal Board at Rothes Colliery.

Two of the largest four-rope friction winders made, with a drum dia. of 16 ft. and working to a final depth of nearly 4,000 ft., with a winding capacity of 450 t.p.h., have also been manufactured and recently installed at Wolstanton Colliery, as have the two towers and friction winders at the new National Coal Board colliery at Bevercotes. Among other recent winder installations are those at Kiltord, Maltby and Brodsworth Collieries.

At the present time, other electric winders are in the course of manufacture for the programme of reconstruction at several of the largest collieries in the country.

A major contribution to the modernization and mechanization of the mining industry has been made by Markhams, who have developed special purpose machinery for the disposal of stone and other debris underground, and to control an allied problem in mining areas, that of surface subsidence. Indeed, the application of power stowing is spreading through the coalfields of Great Britain and abroad and is also employed in metalliferous mining.

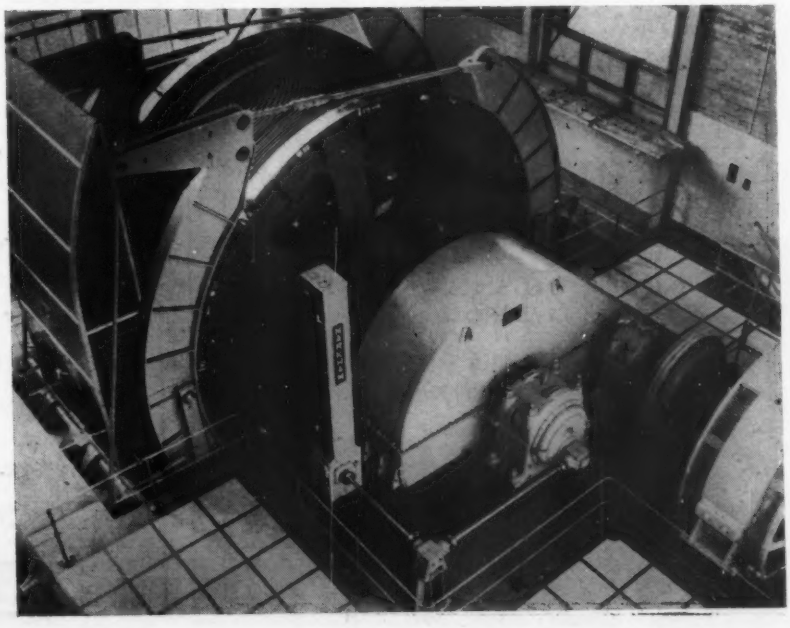
Ancillary equipment produced for pneumatic stowing purposes includes tipplers for handling pit tubs and mine cars, and plant for preparing waste rock to suitable dimensions with pipeline items and other special details.

It will be recalled that the wide range of stowing equipment manufactured by Markham and Co. Ltd. was the subject of a comprehensive article in our issue of March 18, 1960.

Other Equipments

In collaboration with their associated company, the Special Engineering and Nuclear Division of John Brown and Co. Ltd., the field of nuclear engineering has been entered with the design, manufacture, and installation later this year of a refuelling machine for the advanced gas cooled reactor project of the U.K. Atomic Energy Authority at Windscale, Cumberland. The unique machine, which is 60 ft. in height and weighs 400 tons, will be used for charging and discharging.

Parallel drum geared winder supplied by Markham and Co. Ltd. to the N.C.B.



Metals and Minerals

Steady Silver Price Forecast for 1961

The salient features in the silver market last year were the revived interest in forward delivery in London and large scale selling by China both in London and Europe, state Samuel Montagu, in their annual bullion review for 1960.

Speculative hedging in silver was prompted largely by the drain on the U.S. Treasury's stocks of "free silver" which aroused hopes of a rise in the price of the metal.

Throughout 1960 a general shortage of world supplies and the high level of silver prices forced U.S. industrial consumers to draw on Treasury free stocks to the extent of some 2,500,000 oz. At the same time the U.S. Mint used about 46,000,000 oz. for its subsidiary coinage. Taking into account Lend Lease repayments, partly offsetting those losses, the free stocks in the U.S. declined during the year by more than 50,000,000 oz. leaving a balance of 123,500,000 oz. With the repayment of all outstanding Lend Lease silver, including the 21,300,000 oz. still owed by Saudi Arabia, for which no repayment arrangements have yet been made, about 44,000,000 oz. could be added to the free stocks, but even so at last year's rate of withdrawals it would seem that the pile could be exhausted in less than three years.

Silver production has fallen short of world demand for many years and, up to now, the gap has been closed mainly by offerings from demonetized silver coinages and at one time by sales of Russian silver. However, the steadily increasing industrial use of silver and, indeed, the revival of silver coinage in a number of countries has raised the consumption of the white metal even further above current world production, and potential stocks available to reinforce the supply of newly mined metal would seem to be dwindling, says the report.

Russian sales no longer enter into the picture, while demonetization programmes are, or very nearly completed, and so long as the U.S. pursues its present silver policy and makes no amendment to its leglislation, notably the Acts of 1934 and 1946, the drain on the U.S. free stocks will continue.

The only source of non-production silver which holds any promise of expansion seems to be China whose silver sales have featured prominently in London and elsewhere during the last two years. China's silver holdings are no doubt immense and it is anyone's guess how much coin, secondary metal and sycee (lumps of uncoined silver assayed and stamped) was drawn into official coffers during the Communist revolution, but the Chinese refining capacity could be a limiting factor in the supply to world markets.

Looking to the near future in the London market, the report says the supply stringency will ensure a firm undertone but, provided the U.S. Treasury continues to meet the marginal needs of the U.S. domestic consumers, the only authorized customers, a runaway rise in prices is not foreseen in 1961. On the contrary, some re-selling at maturity of the recent considerable forward purchases could even cause a temporary setback in prices, especially if it coincides with seasonal slackness in industrial demand. However, if the pressure being exerted upon the U.S. authorities by mining interests to withdraw from the market succeeds, a strong upward movement in prices would probably ensue.

In the distant future, however, higher prices seem inevitable. Silver production, because it is mainly a by-product of base metal mining, does not expand *pari passu* with rising silver prices and the prospects of substantial non-production supplies, apart from China, are doubtful.

World production of gold, with the exception of the U.S.S.R., in 1960 is estimated by Samuel Montagu at 33,900,000 oz. compared with 32,500,000 oz. in the year before. Turnover in the London market, in spite of the virtual absence of Central Bank activity during the final quarter, increased last year by some 30 per cent over 1959. While the U.K. imported substantially less gold from the U.S.S.R. last year than in 1959, it is believed that large quantities were sold to European Central Banks. Purchases of gold by U.S. interests in both Europe and Canada were generally considered to be extremely large, but probably not exceeding $100,000,000 in the last quarter of 1960, while re-selling so far has been on an extremely small scale.

WOLFRAM PRICES LOWER

Wolfram ore shipment prices have continued to weaken in London and dealers now indicate a range of 119s.-124s. per l.ton c.i.f. Europe compared with 120s.-126s. previously. With prices falling and supplies adequate, buyers are inclined to hold back.

U.K. BENTONITE AGENCY

The Fullers' Earth Union Ltd., of the Laporte Group, have concluded an agreement with the Archer-Daniels-Midland Company of New York to become the sole sales distributor of "Federal Green Bond" bentonite in the United Kingdom.

AUSTRALIA MODERNIZES RUTILE PLANT

Modernization of the plant of New South Wales Rutile Mining Company Pty., may result in its becoming one of Australia's largest producers of rutile and zircon and the intended scale of operations, it is believed, should make it competitive even in the present depressed state of the market.

ANTIMONY ORE MARKET FIRM

The upward pressure in the open market for antimony ore continues. For basic 60 per cent material prices are now indicated at around 28s. 6d. per l.ton unit c.i.f. Continent, a rise of 2s. 6d. on the end-1960 price. While the Continent is perhaps not showing quite so much interest as it has recently, further afield, India, Japan and the U.S. are reportedly buyers. The availability of supplies is probably assuming as much significance as demand in imparting a firm tone to the market. Less ore is believed to be coming from Bolivia.

In Britain, whose ore requirements are mainly covered under long-term contracts with S. Africa, similar conditions prevail, basic 60 per cent ore being quoted at about 23s. 6d. with the likelihood that above this level would have to be paid for any useful marginal needs.

The generally firm tone of the ore market is undoubtedly underpinning the U.K. domestic antimony prices, which were raised by £10 at the beginning of this year to £217 10s. per ton and £210 per ton delivered for 99.6 and 99 per cent grades, respectively. A similar upward revision was made on September 12 last year.

Chinese 99.6 per cent grade has been mentioned at about £168 per tonne c.i.f. against £166 recently. On a delivered U.K. basis, after taking into account the 25 per cent import duty, it would be too close to the price of U.K. produced metal to attract buyers.

QUICKSILVER MARKET STEADY

No significant changes have occurred in the British quicksilver market recently. The London ex-warehouse price is still quoted at £69 per flask although dealers have admitted that the level of fresh demand is slow and a lower price would be accepted for any reasonable orders.

U.K. imports in January were well below the December level of over 4,000 flasks, largely because of arrivals from Spain totalling only 700 flasks against 1,750 flasks. Imports from Italy in January were unchanged at 1,000 flasks compared with December, as were those from the U.S.S.R. at 600 flasks.

According to figures issued recently by the Central Statistical Institute of Rome, Italian exports of quicksilver in 1960 totalled 54,000 flasks against 36,000 flasks. In view of heavier shipments last year it is believed that further inroads were made into stocks since production was reported to have been reduced. Present stocks are thought to be around 50,000 flasks, considerably less than they were a few years ago. While Spain exported about the same volume last year stocks there are understood to be negligible.

URANIUM TAXATION CONCESSIONS EXTENDED

The Australian Federal Government has decided to extend to 1968 the current taxation concessions on the mining and treatment of uranium ore, after reviewing the problems likely to arise from a reduction in demand for the ore.

CANADIAN MOLYBDENITE

In spite of the reduced demand for molybdenum by the steel industry the Molybdenite Corporation of Canada expects to be able to sell all the molybdenum that it can produce during the current fiscal year. Mr. Paul Ranger, president of the company has stated that although a higher daily tonnage of ore was being treated, the lower demand from the steel industry was reflected in lower profits. However, ore reserves

have increased and the company intends to raise the level of output in 1961.

Preissac Molybdenite Mines Ltd. in which Molybdenite Corp. holds a 48 per cent interest has an indicated tonnage of 1,250,000 tons. Production is expected to start in 1962.

BRIGHT PROSPECTS FOR LITHIUM

World reserves of lithium are more than adequate to meet present demands but its use in industry will continue to increase, according to a paper presented at the 90th annual meeting of the American Institute of Mining, Metallurical and Petroleum Engineers at St. Louis, U.S.

In spite of the setback to the industry about a year ago after the AEC contracts had been fulfilled, prospects for the lithium industry are regarded as extremely bright. In the industry there is a strong feeling that the technology of lithium is young and the potential uses are still untapped. The lithium-aluminium alloy X-2020 developed by Aluminum Company of America, it is believed, could intensify research into uses of the metal.

While in 1959 U.S. domestic production of lithium minerals was 55 per cent less than in 1958, production of lepidolite at the property of Bikita Minerals Ltd. in Southern Rhodesia was approximately the same as in the previous year. High grade ore supplied from Bikita is still in demand by the glass and the ceramic industries.

ALUMINIUM FROM CLAY

Olin Mathieson Chemical Corporation has announced that it believes it can produce bauxite from ordinary clay as cheaply as from bauxite. Plans are reported to be under way to evaluate the process further and the company is prepared to spend well over $50,000 "verifying" its development. The new process enables alumina to be extracted from clay or coal shale by separating aluminium sulphate from these materials, and it is claimed that the number of steps in the production of alumina would be reduced. It has been further stated that the new process would be competitive with conventional techniques. At present the cost of making a ton of alumina using the established techniques is $50-$55, including shipping costs of bauxite. No time period for commercialization of the process has been indicated, but in view of the technical problems this is presumably a fairly long-term project.

The U.S. Reynolds Aluminium Corporation is reported to have submitted draft plans for the establishment of an aluminium plant to the Turkish Government. The cost of the project is estimated at $25,000,000. Turkey has substantial bauxite deposits which are unexploited. Some are located in areas not at present readily accessible, but it is hoped that they will be opened up in the near future

The Turkish Government is understood to be interested, as a matter of principal, in the development of electrometallurgical industries. An electrolytic copper plant is under construction in Istanbul and a ferro-chromium plant is being set up in co-operation with a French group.

NEW NICKEL ALLOY STEEL

Scientists of Inco have discovered and developed what is claimed to be a revolutionary new 18 per cent nickel alloy steel with hitherto unattainable physical characteristics, especially toughness at the highest strength levels of traditional alloy steels.

With a nominal composition of 18 per cent nickel, 7 per cent cobalt, 5 per cent molybdenum and less than 0.5 per cent titanium and a maximum of 0.05 per cent carbon, the new steel opens up advanced engineering possibilities for defence and civilian applications involving exceptionally high pressure and stress. Tests have shown the new alloy to possess a remarkable resistance to delayed cracking when exposed to severe corrosive atmosphere in a highly stressed condition. Ingots up to 23 in. by 42 in. have been rolled into plate on conventional steel mill equipment, and because of unusually low work-hardening tendencies extensive cold forming and shaping is not difficult. Excellent machining characteristics are claimed for the metal both in its rolled and fully hardened state.

Production is still in the pilot stage and no information is yet available on either price or the size of the potential market for the new steel.

Copper · Tin · Lead · Zinc

(From Our London Metal Exchange Correspondent)

The prices of the four metals have not shown any uniform trend during the week and in general interest has been at a lower level than recently. It is understood, however, that pricings by consumers against long term contracts have remained satisfactory.

COPPER MARKET QUIET

The copper market in London, after firming up on confirmation that copper shipments from Chile were being held up by the dock strike, developed a weaker tendency in the middle of the week. Stocks in official warehouses fell unexpectedly by 250 tons to a total of 15,265 tons and this caused a slight narrowing in the contango. In the U.S. the scrap price has once more been raised to 23¼ c. per lb., at which level fair tonnages are said to be changing hands. The market for electrolytic copper is described as satisfactory and some consumers are at last becoming a little more optimistic.

In general, the copper picture is at present very quiet, and no major movement in price is anticipated. This leads the majority to believe that a slight downward tendency will persist until after the Easter holidays.

TIN'S UNDERLYING STRENGTH

The tin market is giving evidence of its underlying strength, as any large buying orders are difficult to execute without pushing the price up very considerably. Stocks of tin remained unchanged at the end of last week at 9,990 tons, and there has been no change in the contango rate.

It is interesting to note that the U.S. Bureau of Mines, in reporting on 1960, states that the amount of tin used in the manufacture of tinplate was as much as 32 per cent above the 1959 figure. This adds additional weight to the opinion that stocks in the hands of U.S. consumers must now be very much below normal. As has been said before, if a consumer demand suddenly arises in the U.S., the tin price will become very firm and vigorous action will be required on the part of the buffer stock manager if he intends to defend the £830 level.

On Thursday the Eastern price was equivalent to £830¼ per ton c.i.f. Europe.

LEAD AND ZINC MARK TIME

The lead and zinc markets are both marking time pending the outcome of the conference in Mexico City, but the price of the latter has declined somewhat owing to the expected arrival of a fair tonnage of overseas metal which has immediately affected the "spot" quotation. As is to be expected under these circumstances, the backwardation has tended to disappear. The only news from Mexico City at the time of writing is that the chairman has made a suggestion that an International Control Agreement should be considered, it is to be assumed on the lines of the International Tin Council. If this suggestion is accepted for discussion, it is obvious that the meeting will have to be adjourned as it is very unlikely that the majority of delegates are briefed on this particular point.

The necessity for cutbacks in zinc production in the U.S. was underlined by the U.S. Bureau of Mines' figures for the mine production of zinc in the U.S. in January, which showed a 13 per cent increase over December and was the largest since May of last year. The increase was largely due to the settlement of labour strikes, especially the one at the Bunker Hill Company's plants, which had been out of action for a large part of the year.

Stocks of lead in official warehouses rose by 485 tons to a total of 10,906 tons, whilst stocks of zinc rose 519 tons to a total of 3,558 tons.

U.K. JANUARY STATISTICS

The British Bureau of Non-ferrous Metal statistics for January are as follows, with the December figures in parentheses (in tons):

Copper :		
Consumption ...	59,155	(56,279)
End of month* ...	122,694	(114,452)
Tin :		
Consumption ...	1,803	(1,588)
End of month* ...	11,865	(11,778)
Lead :		
Usage	31,145	(30,148)
End of month* ...	71,660	(70,853)
Zinc :		
Offtake	28,737	(28,481)
End of month* ...	63,152	(59,397)

*stocks.

OFFICIAL TURNOVERS

Official turnovers in l.tons for the week ending March 18, with the previous week's figures in parentheses, are:—

Copper	14,025	(10,525)
Tin	1,255	(1,005)
Lead	10,650	(8,500)
Zinc	9,050	(6,725)

LONDON METAL AND ORE PRICES, MARCH 23, 1961

METAL PRICES

Aluminium, 99.5%, £186 per ton
Antimony—
English (99%) delivered, 10 cwt. and over £210 per ton
Arsenic, £400 per ton
Bismuth (min. 1 ton lots) 16s. lb. nom.
Cadmium 11s. 0d. lb.
Cerium (99%) net, £15 0s. lb. delivered U.K.
Chromium, Cr. 99% 6s. 11d./7s. 4d. lb.
Cobalt, 12s. lb.
Germanium, 99.99%, Ge. kilo lots 2s. 5d. per gram
Gold, 250s. 7d.
Iridium, £20/£23 oz. nom.
Lanthanum (98%/99%) 15s. per gram.
Magnesium, 2s. 2½d./2s. 3d. lb.
Manganese Metal (96%/98%) £275/£285
Nickel, 99.5% (home trade) £600 per ton
Osmium, £18/£22 oz. nom.
Osmiridium, nom.
Palladium, Imported, £8 12s. 6d.
Platinum U.K. and Empire Refined £30 5s.
Imported £28/£28¼
Quicksilver, £69 ex-warehouse
Rhodium, £43/£45 oz
Ruthenium, £14/£16 oz. nom.
Selenium, 46s. 6d. per lb.
Silver, 79½d. f. oz. spot and 80d. f'd.
Tellurium, 28s. 6d. lb.

ORES AND OXIDES

Antimony Ore (60%) basis		25s. 0d./27s. 6d. per unit c.i.f.
Beryl (min. 10 per cent BeO)		250s./260s. per l. ton unit BeO
Bismuth		65% 8s. 6d. lb. c.i.f.
		18/20% 1s. 3d. lb. c.i.f.
Chrome Ore—		
Rhodesian Metallurgical (semifriable 48%)	(Ratio 3 : 1)	£15 5s. 0d. per ton c.i.f.
" Hard Lumpy 45%	(Ratio 3 : 1)	£15 10s. 0d. per ton c.i.f.
" Refractory 40%		£11 0s. 0d. per ton c.i.f.
" Smalls 44%	(Ratio 3 : 1)	£13 5s. 0d. per ton c.i.f.
Baluchistan 48%	(Ratio 3 : 1)	£11 15s. 0d. per ton f.o.b.
Columbite, Nigerian quality, basis 70% combined pentoxides	(Ratio 10 : 1) $Nb_2O_5 : Ta_2O_5$	165s./170s. 0d. per l. ton unit c.i.f.
Fluorspar—		
Acid Grade, Flotated Material		£22 13s. 3d. per ton ex. works
Metallurgical (75/80% CaF_2)		156s. 0d. ex. works
Lithium Ore—		
Petalite min. 3½% Li_2O		50s. 0d./55s. 0d. per unit f.o.b. Beira
Lepidolite min. 3½% Li_2O		50s. 0d./55s. 0d. per unit f.o.b. Beira
Amblygonite basis 7% Li_2O		75s./85s. per ton f.o.b. Beira
Magnesite, ground calcined		£28 0s./£30 0s. d/d
Magnesite Raw (ground)		£21 0s./£23 0s. d/d
Manganese Ore Indian—		
Europe (46%-48%) basis 60s. 0d. freight		73d./75d. c.i.f. nom.
Manganese Ore (43%-45%)		69d./71d. c.i.f. nom.
Manganese Ore (38%-40%)		nom.
Molybdenite (85%) basis		8s. 11d. per lb. (f.o.b.)
Titanium Ore—		
Rutile 95/97% TiO_2 (prompt delivery)		£25 10s. 0d. per ton c.i.f. Aust'n
Ilmenite 50/52% TiO_2		£11 10s. per ton c.i.f. Malayan
Wolfram and Scheelite (65%)		119s. 0d./124s. 0d. per unit c.i.f.
Vanadium—		
Fused oxide 95% V_2O_5		7s. 6d./8s. per lb. V_2O_5 c.i.f.
Zircon Sand (Australian) 65-66% ZrO_2		£16/£16 10s. ton c.i.f

	March 16		March 23	
	Buyers	*Sellers*	*Buyers*	*Sellers*
COPPER				
Cash	£224	£224½	£226	£226½
Three months ...	£225½	£225¾	£227½	£227¾
Settlement ...	£224½		£226½	
LEAD				
Current ½ month	£66¾	£67	£67¼	£67½
Three months ...	£68	£68¼	£68¼	£68½
TIN				
Cash	£815	£815½	£823½	£824
Three months ...	£817	£818	£826	£826½
Settlement ...	£815½		£824	
ZINC				
Current ½ month	£86½	£86¾	£84¼	£84½
Three months ...	£84¼	£84½	£83¾	£84

Mining Finance

A Year of Transition for Rio Tinto's Canadian Uranium Operations

As a curtain raiser to the 1960 results of the London parent concern Rio Tinto, due early next month, come the annual reports of the new amalgamated Canadian uranium concern, Rio Algom Mines, and of the Rio Tinto Mining Company of Canada which owns a 38 per cent interest therein. In turn Rio Tinto in London holds over 80 per cent of the Rio Canada equity. The 1960 picture for the two Canadian concerns is confused by the fact that this was the year of re-organization for Canadian uranium production as a result of the stretched-out delivery plans under the revised contracts with the U.K. and U.S. Governments. This led to Rio Algom being formed on June 30 as an amalgamation of the Algom, Milliken, Northspan and Pronto producing companies in order to streamline the whole uranium production operation at Elliot Lake.

The contracts now run until November 30, 1966, and the president of Rio Algom, Mr. Robert H. Winters, is able to say that "the road ahead for the uranium companies is now much clearer than before even though some of the hopes and expectations of earlier days have had to be relinquished. Nevertheless, your directors are confident that as a result of the re-organization an efficient operating unit has been created which will function profitably through 1966, at which time it should have an established position in a growing market for uranium used as a fuel in nuclear reactors and for other purposes".

Meanwhile, Rio Algom and its predecessors report a net profit of $27,411,422 for 1960 after providing $42,237,324 for amortization and depreciation. It should be noted, however, that out of this revenue $5,981,024 is being deferred to future periods under a scheme designed to iron out undue fluctuations in earnings caused by variations in the contract prices for uranium. This ironing out is being done by bringing the production for each financial period into revenue at the average selling price of the contracts.

Despite this substantial profit Rio Algom is paying no dividend for the past year. This is because of the necessity for paying off the substantial funded debt. How successfully this has been done can be judged by the fact that whereas the total of such debt stood at close on $100,000,000 at the beginning of 1960, it was only $12,637,500 on Wednesday of last week. Consequently the directors think it likely that Rio Algom "will be in a position to consider payment of dividends towards the end of 1961".

THE CANADIAN HOLDING COMPANY

The year of transition has hit Rio Canada to the extent of a drop from $2,756,812 to $482,623 in the consolidated net profit. The decline in revenue was "due to the interruption in the flow of dividends from Algom and Pronto" it is stated. This interruption does not, of course, arise from any sinister cause. The two companies were among the four merged into the Rio Algom set-up and the combined concern, as outlined above, has been so far precluded from continuing dividend tradition owing to its inheritance of funded debt notably that of the Northspan undertaking, a debt that, as already explained, has now been reduced to manageable proportions.

Of particular interest to Rio Canada shareholders is the paragraph in the annual report dealing with the need to diversify the company's activities in which it is stated that "the earnings from uranium operations in the coming years are expected to be substantial and many possibilities have already been examined in the search for alternative activities in which funds may be invested in order to provide for continued expansion". Exploration for other mineral projects in Canada is thus being actively pursued.

The auditors' report on Rio Canada's balance sheet again includes a qualification that the market value of quoted investments is appreciably less than cost, but the Board, also once again, does not propose to do anything about this except to appropriate the year's profit in order to write down the cost. Last year it was stated that until a better assessment could be made of the market for uranium it was not possible for any general policy to be adopted regarding the value of the uranium shareholdings. At that time it was generally understood that in the opinion of the directors the market value during the transition period was unrepresentatively low.

OVERSEAS COMPANIES OF GREATER IMPORTANCE

From the viewpoint of a shareholder in Rio Tinto itself the earnings and dividends of these overseas offshoots could become a much more vital factor if, in the U.K. Budget next month, the Chancellor could bring himself to follow up the enlightened Overseas Trade Corporation tax legislation in 1957 with a logical extension of its provisions to the earnings of actual local subsidiary companies abroad, instead of it being confined as now to the earnings from operations abroad run directly from London. If last year's time-table is followed Rio Tinto will have announced its 1960 results and dividend before the Budget, due on April 17. But in the annual report and chairman's statement there will be plenty of opportunity to comment on the implications for Tinto's world-wide finances of any amending legislation along these lines.

THE OIL DEAL WITH B.P.

Another subject that will no doubt be expanded upon is the important step just announced of selling the bulk of the subsidiary Kern Oil company's interests to British Petroleum for 3,000,000 new £1 Ordinary shares in the latter which at the current market price are worth around £8,700,000. Tinto acquired Kern way back in 1957. It regards the ad-

London Market Highlights

After the downslide in South African gold share prices which followed the news of South Africa's exit from the Commonwealth it seemed that the market was due for a period of quiet convalescence. Market observers pointed to the fact that the fall in prices was not accompanied by any real selling pressure and that it was still none too easy to buy any sizeable amounts of stock in the prevailing "thin" conditions. Thus, it was argued, any cautious bargain hunting would soon be reflected in higher prices.

This reasoning had not taken into account the fact that Tuesday of last week was the anniversary of the Sharpeville riots. Consequently, the week opened with prices being again marked down sharply as a precautionary measure, both here and in Johannesburg, against the possibility of further unrest in the Union. However, no disturbing news made its appearance on Tuesday and Orange Free State Investment (67s. 6d.) and Free State Geduld (103s. 9d.) each regained 1s. 3d. of the 5s. falls which had been sustained on the previous day. The rest of the market cautiously edged ahead and remained steady, if rather unexciting, in dealings on Wednesday.

Before the Commonwealth crisis erupted, Rhodesian copper shares had been quietly moving higher on a growing feeling that the political outlook for the Federation was showing signs of changing for the better. The setback in Kaffirs checked this market improvement for a while, but on Tuesday coppers again started to rise with Chartered gaining 1s. 6d. to 68s. 9d. But by far the most outstanding feature of coppers, if not of all mining sections, was a sudden U.S. demand for Rhodesian Selection Trust. On Wall Street the shares shot to the top of the list of most active stocks while in London an almost exclusive U.S. demand raised the share price from 8s. 4½d. to 11s. in two days. London dealers were mystified by the move; the only reasonable explanation given was that U.S. investors had detected stronger signs of an improvement in the Federation's political outlook than had been seen here and were keen to follow the lead set by one of their independent oil companies which had announced plans to build an £8,000,000 oil refinery in Rhodesia.

Tin shares moved further ahead for a while, sentiment again being impresed by the strong statistical position of the metal, the forward price of which climbed to a 4½-year peak. Ayer Hitam led the field, as usual, but after advancing from 32s. 3d. to 36s. the shares ran into some profit-taking on Wednesday and reacted to 35s. Hongkong, on the other hand, moved up 1s. more to 15s. 6d. following a persistent demand from Singapore. Attention was drawn to the Nigerian mines which in some cases produce columbite as well as tin. The result was that this overlooked section also started to regain lost ground, Amalgamated Tin of Nigeria rising to 11s. 1½d. Elsewhere, continued firmness in Rio Tinto (41s. 3d.) reflected satisfaction with the Kern Oil deal.

vantages of the present deal as four fold. Instead of owning a small oil company with its attendant disadvantages in this industry of the giants Tinto will have a sizable stake in one of the said giants, moreover one in the shares of which there is a market. It is claimed that no capital loss will be involved in the deal while on the basis of the current B.P. dividend rate there should be some improvement in income. Kern will retain certain of its interests.

The news of this deal caused a fresh recovery in Tinto 10s. units which are now 41s. 3d. against only 30s. at one time earlier this year. In view of the higher revenue that must have accrued from the company's Rhodesian copper investments last year there are some hopes of an improvement in the dividend for 1960 over the twice-covered 2s. paid for the preceding year. The yield offered on a 2s. basis is under 5 per cent, which looks modest besides those being offered on the shares of some other mining houses, but Tinto may be able to loosen its purse strings one of these days and there can be little doubt about the relative strength of the whole organization's asset position.

MESSINA'S STAKE IN RISCO

The annual report of Messina (Transvaal) Development was commented on here on March 3. At the meeting in Johannesburg the chairman, Commander H. F. P. Grenfell, had some further points of interest to make. One concerned the Rhodesian Iron and Steel company (Risco) in which Messina has a 23 per cent stake as well as iron ore royalty rights. With the blowing in of the No. 3 blast furnace this February a £9,000,000 development programme has been almost completed nearly twelve months ahead of schedule. About 300,000 tons of iron from three blast furnaces are expected to be produced in 1960 from this Southern Rhodesian undertaking, of which about 100,000 tons will be absorbed in the steel-making plant and the balance shipped overseas as pig iron under contracts already concluded to the end of March, 1962. Plans are in hand for further expansion at Risco and Commander Grenfell thinks that Messina's stake in it "will prove to be a valuable investment".

Messina operates its original copper-producing property in the northern Transvaal together with three in Southern Rhodesia, that of M.T.D. (Mangula), commented on here last week, Umkondo and now Alaska which is currently making a delayed production start. A new smelter to treat the Mangula and Alaska concentrates started up in December. Umkondo now looks to have a remaining life of only about two years and it was hoped to replace it with another mine Sanyati, but the exploitation of this property is unfortunately having to be postponed partly owing to the fact that it is not opening up so well as originally expected, while, as the chairman points out, in the present political situation in Southern Africa the raising of capital for such a project "would be difficult, if not impossible".

Production costs at Messina itself last year were equivalent to £130 a ton, a satisfactory figure, and Messina as a whole must be doing quite well in its current financial year, especially as there is no indication that the company is joining in the world-wide move to cut back production voluntarily by 10 per cent in order to cure the present over-supply position of the metal. The 5s. units, overshadowed, of course by politics, are 16s. to yield not far short of 14 per cent without allowing for double tax relief on dividend of 44 per cent for the year to last September.

SURPRISES FROM UNION CORPORATION

Union Corporation announces a consolidated net profit for 1960 that is up by as much as £831,543 at £3,688,458 and the dividend for the year is raised from 3s. 9d. per 2s. 6d. share to a less tax equivalent of approximately 4s. 0½d. by a final of 18½ c. in South Africa's new currency free of U.K. tax. It is stated that "in the interests of simplicity" the 1960 final and future dividends will be free of tax and will be declared in Rand and cents. Until 1954, the corporation used to declare its dividends free of tax.

The main reason for the big rise in profits in a disturbing year for South Africa generally appears to be that Winkelhaak, the new producer in the Kinross gold field, ranks as a subsidiary. Consequently net revenue from mining operations has jumped from £708,879 to £2,448,906, a reflection of the rapidly increasing profits of this mine. Dividends and interest are up from £,244,799 to £2,488,359. This item will have been helped by the sharply higher payments by St. Helena in the Orange Free State. Realized profits on investments are £395,123 down at £1,106,010.

The Union Corporation distribution absorbs £1,231,250 so that it is very handsomely covered by the consolidated net profit, but, of course, the actual proportion of Winkelhaak profits will only for practical purposes accrue to the corporation in so far as they are paid out in dividends. Winkelhaak paid a maiden 4d. for 1960 and has declared an interim of 6d. for 1961.

A controlling interest has also been retained by Union Corporation in the two embryo mines in the Kinross field, Leslie and Bracken, the profits of which when they reach the production stage will thus also be consolidated into Union Corporation's accounts less those accruing to outside shareholders which in the case of Winkelhaak last year took away £732,438 from the £2,448,906 already mentioned. Winkelhaak, which started production in 1958, has already indicated the success of the new field, so that in years to come Union Corporation should be reaping a considerable harvest from its faith in its big new venture well to the east of the Rand proper.

Union Corporation 2s. 6d. shares are 54s. cum the final dividend of approximately 1s. 10½d. tax free to offer a yield of 7.6 per cent. In view of the company's strong asset position and the earnings growth prospects there is little doubt that they would be standing considerably higher than this if it were not for the investment shadow in which South Africa stands.

MORE ABOUT THE BIDS FOR GHANA GOLDS

The Western Selection group are to be congratulated in offering the stockholders in Ariston, Bremang, Amalgamated Banket and Ghana Main Reef an up to date technical and financial picture of these four gold concerns in the light of which to judge the cash bids for them being made by the Ghana Government through the agency of Philip Hill, Higginson, Erlangers. One cannot help thinking that, in mining particularly, this kind of frankness between Boards and their shareholders ought to be commonplace instead of being just switched on in circumstances such as these. By and large, the rather dispiriting picture painted brings sufficient justification for the individual Board's recommendations of the offers as "fair and reasonable", although Ariston stockholders, from whom the greatest amount of criticism has come, will no doubt be surprised at the sharp deterioration in their company's position that seems to have taken place since last year's annual meeting, including the apparent intention to pass the final dividend.

It is interesting to note that in the formal offers that have now gone out to the stockholders in the four companies, plus those of Bibiani in the Ashanti Goldfields group, the percentage interests of associated companies are given. They consist of 37 per cent of Bremang, 14 per cent Ariston and 27 per cent of Ghana Main Reef. A substantial proportion of these holdings will no doubt represent the stake in these concerns of Western Selection itself and it is significant that no percentage is given for Amalgamated Banket. Presumably over the years the bulk of the holdings in this company must have been realized, no doubt a wise move. It continues to be believed that Western Selection will participate in the £5,165,000 cash involved in the bids for all five mines to the extent of some £700,000.

In the case of Bibiani it is stated that West African Finance Corporation, a wholly-owned subsidiary of Ashanti Goldfields, holds 14.6 per cent of the capital. U.K. Treasury consent to the deals has been obtained. The bids are conditional on not less than 90 per cent acceptance or such smaller percentage as the bidding company, the newly-formed Ghana State Mining Corporation, may decide to accept. The closing date is April 12 but this may be extended to not later than May 3. The cash bids per share are Bibiani 4s., Ghana Main Reef 3s., Ariston 4s., Bremang 3s. 9d. and Amalgamated Banket Areas 1s.

Any advice other than acceptance can hardly be offered to the shareholders concerned. This is one of those occasions when to remain a minority stockholder would almost certainly be an uncomfortable and unprofitable procedure.

FOUR PER CENT FINAL FOR LONRHO

With the declaration of a final dividend of 4 per cent the total dividend of London and Rhodesian Mining and Land for the year ended September 30, 1960, has been increased to 8 per cent (4.8d. per stock unit). This compares with the previous year's payment of 7½ per cent and it will be recalled that this was in respect of a 15-month period due to the change in the financial year end.

This is a generous dividend payment by comparison with previous years. In the past the directors have considered it wise to transfer considerable sums to the general reserve, but this year, with the account standing at £249,373, this appropriation has been discontinued. Thus it has been possible to make a higher dividend payment despite the fact that the net profit for the year has fallen by almost £20,000 to £66,484.

PETALING TIN LTD.

MR. D. C. THOMSON'S REVIEW

The thirty-fifth annual general meeting of Petaling Tin Ltd., was held on March 17, in Ipoh, Malaya.

Mr. D. C. Thomson, Chairman, presided.

The following is his Statement dated January 28, 1961, circulated with the Report and Accounts for the year ended October 31, 1960 :—

The year under review was one of improving conditions and the net profit of $959,295 (£111,918) showed an increase of $265,395 (£30,963) over the previous year after providing for depreciation and property redemption.

Capital expenditure during the year included the balance of $171,505 (£20,009) in respect of the purchase of 595 acres of Castlefield Estate and payments amounting to $274,293 (£32,001) which included expenditure on the river deviation and acquisition of plant.

Contributions having ceased in August 1959 the Company's funds held by the Buffer Stock Fund remained at $874,772 (£102,057).

An interim dividend of 15% was paid on September 19, 1960, and it is proposed to recommend the payment of a final dividend of 20 cents per dollar stock unit at the Annual General Meeting.

Upon recommendations put forward by the General Managers, your Directors decided to equip and develop an opencast mine in the deep enrichment located in the area previously worked by Nos. 3 and 4 Dredges.

In order to finance this venture and clear the Bank overdraft a proportion of the Company's investments were sold as it was considered that by thus employing these funds they would be more profitably utilized. This mine is expected to commence operations within the next few months.

International Tin Agreement

As the year progressed, quota releases under the International Tin Agreement increased to the extent that it was no longer possible to meet the domestic requirements by the operation of only one dredge and a study of the General Manager's report provides details from which it will be seen that No. 6 Dredge worked throughout the year and No. 4 Dredge resumed operations on September 1, whilst arrangements were well in hand to refit No. 3 Dredge for an early resumption. The decision to recommission No. 3 Dredge, an oil-burning unit, was made more practicable by the subsequent revision of the tax on fuel oil which operated so severely against the economic operation of such units. No. 5 Dredge, however, remained on a care and maintenance basis and its utilization is constantly under review.

The operation of the International Tin Agreement continued to maintain a stable tin price, and progressive increases in the quotas were such, that by the end of the Eleventh Period the domestic release was comparable with pre-restriction production. Accordingly the International Tin Council at its meeting in August 1960 decided not to declare a Permissible Export Amount for the Twelfth Period (October to December 1960) thus suspending restriction of production.

Despite an easing of the demand by the largest consuming country, the United States of America, the market has remained stable to the great satisfaction of producers.

In conformity with the provisions of the existing International Tin Agreement, which expires on June 30, 1961, the contracting Governments conferred with a view to deciding whether a new, or Second, Agreement should be entered into and it was unanimously agreed to do so. The Federation Government has since confirmed ratification of the Second Agreement which was adopted at the meeting of the United Nations Tin Conference in New York on June 24, 1960. As a corollary of these events, the liquidation of the present Buffer Stock Fund and establishment of a new one will be necessary and it is hoped that substantial repayments will be made to producers when that occurs in the middle of 1961.

Malaya—Mounting Costs and Taxes

Having surmounted the difficulties of the last two years, the Industry faces the problem of mounting costs and taxes. The Government's farseeing plans for social and other improvements have called for increased revenue which has to be provided from heavier and new taxes and an expanding economy.

This is understandable and appreciated, but the imposition of heavy taxes on the Tin Industry can have a stultifying and crippling effect to such an extent that production by many of the country's producers is rendered uneconomic. There comes a point, and it would appear to be not far distant, where the numbers able to carry the burden will be considerably fewer and it is a moot point whether a policy of heavily taxing a reduced number will sustain revenue.

There are signs that Malaya's production will decline and a policy which discourages operations and renders uneconomic the exploitation of lower-grade deposits, from which a considerable proportion of ore is obtained, is irreconcilable with the problems of maintaining this country's position as a major world producer of tin.

The employment of large capital sums and the reinvestment of earnings, which is a feature of mining the world over, can no longer be contemplated when opportunity to do so is denied by unfavourable conditions. Mining is a very speculative business but operators are always prepared to develop a venture given reasonable conditions; opportunities, however, have declined and the chances of successful new ventures are greatly reduced. It would appear that the time is appropriate to review the future of the Industry in relation to Governnment policy in financial and land matters .

Providing the market remains stable and there is no return to restriction of production, the Company's prospects for the next financial year are favourable.

The Company's staff and labour force gave continuing efficient and loyal service and our thanks are due to all at the mine.

Chairman's Additional Remarks

The Chairman, addressing the meeting, said:—

At a time when increased ore outputs are desirable to meet the world's requirements it is natural that we should be anxious to find a use for No. 5 Dredge. This dredge is steam-operated and has a maximum digging depth of 82 feet and because of this its value as a potential producer is accordingly limited in scope. The Company has been striving to obtain suitable land, but it must be borne in mind that considerable expenditure would be necessary to fit the dredge for service elsewhere if the large area which is necessary could be found to justify the expenditure.

The opencast mine is a new venture. We are reasonably confident that it will be profitable, but the use of a bucket wheel excavator is new in this country so far as operation at depth is concerned, and the degree of efficiency and the actual costs have yet to be established in practice. There must be some degree of uncertainty in developing a new method of mining. I am sure members will agree that a progressive policy is justified.

Grab-Dredging

The Company was a member of a syndicate which purchased experimental grabbing plant in 1954 which was operated on a mine other than that belonging to the Company. The experiments were abandoned in 1955 after the limited potentialities of the grab were determined. The syndicate was only recently successful in finding a purchaser for the experimental plant and the sum of $114,443 written off is the difference between the Company's total expenditure and the proportion of proceeds from the realization of the plant.

The report and accounts were adopted.

Board Changes

Anglo American Corporation of South Africa announce that Mr. M. W. Rush has been appointed a director and a member of the executive committee of the board.

★

The International Nickel Co., of Canada announce that Mr. Ivon A. Bailey has been elected a vice-president and Mr. John O. Hitchcock an assistant vice-president of the company effective from April 10. Mr. Bailey remains chairman and chief officer of The International Nickel Co. (Mond) and of Henry Wiggin and Co., Mr. Hitchcock remains managing director of The International Nickel Co. (Mond) and deputy chairman of Henry Wiggin and Co.

★

Mr. Essington Lewis has been appointed president of the Board of Trustees of the Australian Committee for Economic Development. Mr. Lewis has been chairman or deputy chairman of Broken Hill Pty. Co. since 1950.

★

The London Metal Exchange has given notice that the following warehouses have been admitted to the official list of wharves and warehouses for the storage of metals: Ouseburn Warehouse proprietors, R. Steenberg & Sons, Ouseburn Warehouses, Quayside, Newcastle upon Tyne 1; Royal Edward Warehouses B, C and D, Port of Bristol Authority, Queen Square, Bristol, 1.

THE MESSINA (TRANSVAAL) DEVELOPMENT COMPANY, LIMITED

(Incorporated in the Union of South Africa)

CONSIDERABLY IMPROVED TRADING RESULTS

COMMANDER H. F. P. GRENFELL'S REVIEW OF OPERATIONS AND PROSPECTS

The eleventh Annual General Meeting of Members of The Messina (Transvaal) Development Company, Limited was held in Johannesburg on March 16, 1961, **Commander H. F. P. Grenfell, D.S.C., R.N. (Ret'd),** presiding.

The Chairman addressed the meeting as follows :—

Ladies and Gentlemen. It gives me great pleasure to welcome you once again to the Annual General Meeting of your Company and, on behalf of the Board of Directors, to present for your approval their Report and the Audited Accounts of your Company for the financial year ended September 30, 1960. With your permission I propose to take these as read. (Agreed.)

The Copper Market

Before reviewing our year's operations I will deal briefly with conditions and prospects in the copper market as these have a direct effect on the prosperity of your Company.

As we have seen so often in the past, the market is extremely susceptible not only to strikes within the industry itself, but also to political and economic events generally throughout the world, and in this respect the past twelve months have proved no exception.

At this time last year the supply pipelines between the producers and the consumers of copper had been appreciably drained as a result of the series of strikes in the United States, which began in the summer of 1959 and continued until March 1960. The view was also expressed at that time that with the return to normal working in the steel industry, business activity in the United States might reach a record level during the year.

In the event this did not materialize, and once the pipelines were again full and buyers were able to replenish their stocks, the effect of the industry's greater productive capacity began to be increasingly felt. Although from time to time there were sporadic rallies caused by uneasiness over the situation in the Congo and the threat of further labour troubles in Chile, the overall trend of prices was downwards for the latter part of our financial year.

As regards the current year the position is that there is still a potential surplus of production over consumption—a situation that is aggravated at present by the low level of business activity in the United States. A number of the major producers have however, recently announced cuts in their production and it is to be hoped that these will be effective in stabilizing prices at levels reasonable to both sides of the industry.

Looking to the future it is clear that the political and economic changes now taking place in the under-developed areas in the world must eventually secure a higher standard of living for many millions of people. This fact alone must surely result in an increasing demand for copper and other commodities, and I continue to take a confident view of the long term prospects of your Comany.

The Year's Results

As forecast in my speech last year, the results submitted to you today show a considerable improvement on those for the previous year. The net profit of the Group after providing for taxation was £1,594,840—an increase of over £500,000, to which must be added a profit of £164,757 derived from the sale of investments and the redemption of Loan Stock, making a total of £1,759,597.

Of this, the profit attributable to your Company was £1,645,656 including £462,850 received by way of Mangula dividends. This enabled your Directors to declare dividends amounting to £1,083,500 compared with £756,500 the previous year, and to transfer £500,000 to reserves, while unappropriated profits of £67,248 have been carried forward to next year.

Operational Activities

Turning now to the operational activities of our Group, there is nothing unusual to report from Messina although you will have noticed that there has once again been a small increase in Ore Reserves despite the year's production of well over 900,000 tons.

Working costs increased from 31/11 to 33/4 per long ton of ore produced, but I hope this is only a temporary increase as it is mainly due to a change in accounting procedure relating to the provision for contingent annual leave pay and bonuses. The cost per long ton of recoverable copper was £130 which compares with £124 for the previous year.

To meet the growing demands on our Power Plant we have found it necessary to increase its capacity by the installation of an additional 5 Megawatt Turbo Alternator. This should be in commission by the end of the calendar year and I hope it will meet the needs of both Mine and Township for the foreseeable future.

We are also extending the mine railway to Artonvilla to enable larger tonnages to be brought in monthly from that section and to reduce the cost of haulage. This railway should be in operation by the end of the financial year.

In October last year the Liquidator of the Northern Transvaal (Messina) Copper Exploration Limited offered for sale by public tender the mining lease and claims owned by that Company. These are situated between six and ten miles from Messina on the same fault that runs through our own property and are shown on the plan enclosed with this year's Report.

Our tender was accepted by the Liquidator, and we are now reclaiming the shaft and underground workings and have put in hand a general prospecting campaign on the property. I hope to be able to give you more details of this new acquisition at our next meeting.

I am glad to be able to conclude my remarks on Messina by reporting to you once again that our labour supply—both European and African remains satisfactory, and that we continue to enjoy excellent relations with all our employees. Indeed this happy state of affairs applies throughout all the mines in our Group, and remains an outstanding feature of our organization.

Southern Rhodesian Interests

Turning now to our interests in Southern Rhodesia I begin with Umkondo where the removal of the overburden from the opencast workings has been completed. As a result it may be expected that working costs will be much reduced during the remainder of the Mine's life. You will recall that originally it was only anticipated that the life of this property would be between five and six years. The Mine has already been in operation for this length of time and the available ore reserves are gradually being exhausted. Unless further ore is discovered, which seems unlikely at present, the remaining life of the mine cannot be expected to be more than about two years.

At Alaska the new Smelter began producing high grade fire refined copper in December. I had hoped that it would have been in operation by the end of the financial year, but delays were caused by late deliveries of equipment, and also by an explosion which occurred while testing the waste heat boiler, and resulted I am sorry to say, in the death of one of our employees.

However, although there are still a few teething troubles to be overcome, I am glad to report that the plant is now operating reasonably well, and regular consignments of copper are being shipped overseas. Present indications are that the new "M.R.S.R." brand will be every bit as acceptable to consumers as our own "M.T.D." brand of copper.

Due partly to the delays to which I have referred, and partly to increased costs incurred by improvements in design incorporated since our estimates were originally made, capital expenditure at the smelter has increased by about £275,000 as compared with the original estimate. Arrangements have been made for the additional funds required to be provided by way of loans from the parent Company and M.T.D. Mangula Ltd.

The news from the Alaska Mine is a little disappointing—serious delays in the delivery of plant for the Mill has meant that the Mine will only be brought into operation at the end of this month. It is expected to produce approximately 2,600 long tons of copper a year in the form of concentrates which will be smelted and refined at the new Smelter, and will provide a useful increase in the total production of your Company.

Production Target Achieved

At Mangula, both Mills were in operation for a full year for the first time, and our original production target of 11,500 long tons of recoverable copper was achieved. The net profit amounted to £923,485—an increase of over £500,000 as compared with the previous year.

Last year I reported a reduction in working costs from 27/8 to 25/3 per short ton of ore treated. I am glad to say that this figure has now been further reduced to 20/5, for which great credit is due to the Resident Manager, Mr. Wilson and all his staff and employees.

After allowing for the increased ore production at an average monthly rate of 94,000 short tons, the end of the year showed a slight increase in Ore Reserves, while deep drilling from the surface disclosed payable ore over appreciable widths at a depth of 1,750 feet.

In the Norah area the development to which I referred last year is continuing from the new Harry Shaft and ore of good grade has been encountered, while production has already begun on a limited scale from the Brian Shaft.

At Silverside re-sampling of the old workings has indicated approximately 300,000 tons of predominantly oxide ore averaging 2.18% copper, and a programme of underground development on two levels is now in hand.

Meanwhile we are actively engaged in exploration work elsewhere on the property and our geophysical and geochemical campaigns have disclosed some interesting anomalies in several areas which will be tested by diamond drilling at a later date. All in all I think we have ever reason to be well satisfied at the way things are going at Mangula.

Sanyati Property

I had hoped to be able to present you this year with plans for the exploitation of our property at Sanyati, where our programme of underground development from the Bradfield Shaft is still in progress. However, I cannot do so for the following reasons.

First, it appears from results to date that although the tonnage of Ore Reserves may be substantially greater, the grade may be somewhat lower than originally estimated. Second, the orebodies have been found to occur in highly folded and structurally complex rocks, so that they are therefore very irregular in shape and "clean" mining is unlikely to be possible. It is therefore only prudent to assume that the Mill grade may be appreciably lower than the Ore Reserve Grade. Third, the price of copper, lead and zinc are, at present, considerably lower than they were when we first took over the property.

There is still another factor which cannot be ignored in present circumstances, and that is the political situation, not only in The Federation but in the whole of Southern Africa. The present time is one of doubts and uncertainties, and until these are resolved and confidence in the future is restored, the raising of capital for a project such as this would be difficult, if not impossible.

Consideration of all these factors brings us to the conclusion that it would be unwise at present to make definite plans to bring Sanyati into production.

I appreciate that what I have said may sound rather depressing, but in the light of my remarks last year, I wanted to acquaint you fully with our present ideas. However, I would emphasize that these are only provisional thoughts based on development results from the 200 ft. horizon, and that further work in depth could well change for the better the underground picture. Similarly, higher prices for copper, lead and zinc would have a material effect on the economics of the proposition, while it is surely not too much to hope that with restraint and goodwill on all sides some measure of stability may soon be restored to the political scene.

Risco

My review of our interests in Southern Rhodesia would not be complete this year without a reference to The Rhodesian Iron and Steel Company in which we have a substantial holding. You may remember that following the formation of the Company in 1957, the Directors of RISCO immediately put in hand a £9m. development programme designed to modernize and greatly increase the capacity of the plant.

With the blowing in of No. 3 Blast Furnace last month this programme has almost been completed — nearly twelve months ahead of schedule—and for the first time Southern Rhodesia has an iron and steel undertaking capable of operating on an economic basis.

This year the output of iron from the three Blast Furnaces will amount to about 300,000 tons. Of this total approximately 100,000 tons will be absorbed in the steel making plant, while the balance will be shipped overseas in the form of pig iron under contracts already concluded to the end of March 1962, and will thus be a valuable new addition to the country's export trade.

Contracts have already been placed for a new programme of general extensions to the Works, while plans are being prepared for further increasing the output of the steel making plant to meet the growing needs of the Federation.

You will realize from what I have said that RISCO today is a very live and progressive concern, and I have no doubt that our stake in it will prove to be a valuable investment.

Senior Staff Appointments

This brings me to the end of my review, but before closing I want to refer to several changes in senior staff appointments which have been made since the close of our financial year. On October 31, Mr. P. O'B. Frost, who had been our General Manager for the past 13 years, retired from this position and at our invitation joined the Board of Directors. His great experience, which extends over 42 years with the Company, will be as invaluable on the Board as it was when he was General Manager, and in terms of the Company's Articles of Association you will be asked to re-elect him at this meeting.

Our new General Manager is Mr. W. I. Spence who has occupied various senior positions with the Company since he joined our organization in 1951. Mr. Spence was a conspicuous success as the first Resident Manager at Umkondo and for the last 5 years has occupied a similar position at Messina. I am confident that he will be equally successful as our General Manager.

Consequent upon Mr. Spence's appointment, we have selected Mr. C. H. Irwin as Resident Manager at Messina. Mr. Irwin, who was our Underground Manager at Messina for 10 years, has latterly been Assistant Manager there, and I am sure he will carry out his new responsibilities with efficiency and distinction.

In conclusion it only remains for me to express on behalf of the Board and myself—and I am sure on your behalf also—our thanks to Mr. Frost, who was General Manager throughout the past year, and to all our staff and employees wherever they may be, for their loyalty and hard work during the year.

The Directors' Report and Balance Sheet and Accounts for the year ended September 30, 1960, were adopted.

The retiring Directors, Mr. C. M. Stuart and Mr. P. O'B. Frost, were re-elected and the remuneration of the Auditors for the past year's audit was fixed.

There being no further business the Chairman declared the meeting at an end.

Annual Dinner of the Institution of Mining and Metallurgy

Proposing the toast to the Institution at the Annual Dinner held on March 21 at the Carpenters Hall, Lord Fleck said that he had discovered that the total national product of the whole world was estimated at something like $755,000,000,000 and that the mining industry subscribed $21,000,000,000 of that amount. He also mentioned the important role played in the mining industry by John S. MacArthur, who was responsible for the discovery of the cyanide process for the extraction of gold. This work had influenced the economic situation of the whole world and, of course, had had a great effect on South Africa. In referring to South Africa, Lord Fleck said that he was sure that if it was desired, strong industrial and economic relations could be maintained between that country and ourselves. The Institution had contributed a tremendous amount to the development of the Union and this should be remembered by the people on the political side.

Acknowledging this toast, the President of the Institution, Professor David Williams, referred to the need for a world mineral exploration policy. He said that thought would have to be given to the future mineral supplies, in view of increasing demand which would undoubtedly come. Exploration should be done in a big and far-sighted way and it seemed to him that it should be done by the large mining companies with assistance from their governments.

The President then told members that a local section had been set up in Ghana, and that members in Malaya were studying the possibility of forming a local section there. These local sections were tremendously important, he stated, in furthering the cause of the mining industry and in keeping close contact between the uncommitted nations and the British centre in England.

There followed the toast to the guests which was proposed by Mr. A. R. O. Williams, O.B.E., A.R.S.M., B.Sc., the President-Elect, and was acknowledge by Sir William Pugh, O.B.E., B.A., D.SC., LL.D., F.R.S., formerly Director Geological Survey of Great Britain and Museum of Practical Geology.